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National Institutes of Health

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

Public Health Service

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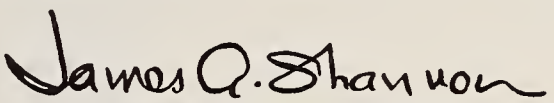
FOREWORD

THE NATIONAL INSTITUTES OF HEALTH, a bureau of the Public Health Service, supports medical research, research training, and construction of research facilities in the Nation's medical and dental schools, universities, and other research centers. It also conducts laboratory and clinical research in its own facilities at Bethesda, Md., and in the field.

The programs of the nine Institutes are designed to obtain new medical scientific knowledge in order to control especially the major killing and crippling diseases of today, such as cancer, heart disease, arthritis, dental and neurological disorders, and mental illness. The role of medical science in promoting better health and longer life is well recognized by the American people. Through continued research leading to increased understanding of the causes, prevention, and treatment of disease, we can become a healthier and stronger Nation.

We at the National Institutes of Health appreciate our great responsibility. We approach our work with humility, but with confidence that we can aid materially in man's conquest of disease.



JAMES A. SHANNON, M.D.
Director, National Institutes of Health

Chronology

1798 President John Adams signs bill establishing Marine Hospital Service for Merchant seamen.

1799 Amending Act extends benefits of Marine Hospital Service to officers and men of U.S. Navy.

1887 Research laboratory is founded at Marine Hospital, Staten Island, N.Y., to meet new responsibilities of Service.

1891 Hygienic Laboratory moves from Staten Island to Service headquarters, Washington, D.C.

1902 Marine Hospital Service name is changed to "Public Health and Marine Hospital Service." Biologics Control Division established in the Hygienic Laboratory and Advisory Board of "competent experts" is created to counsel with it.

1912 Name of Public Health and Marine Hospital Service is changed to "Public Health Service."

1930 Hygienic Laboratory becomes National Institute of Health; Advisory Board of Biologics Control Division becomes National Advisory Council.

1937 Congress authorizes National Cancer Institute.

1938 National Institute of Health moves to land donated by Mr. and Mrs. Luke I. Wilson at Bethesda, Md.

1947 Division of Research Grants established to process NIH grants and fellowships to non-Federal institutions and scientists.

1948 National Heart Institute authorized; other laboratories regrouped to form Microbiological Institute, Experimental Biology and Medicine Institute, and National Institute of Dental Research. NIH becomes National Institutes of Health.

1949 Mental hygiene program of Public Health Service transferred to NIH and expanded to become National Institute of Mental Health.

1950 National Institute of Neurological Diseases and Blindness and National Institute of Arthritis and Metabolic Diseases established, the latter absorbing Experimental Biology and Medicine Institute.

1953 Public Health Service becomes a constituent of newly created Department of Health, Education, and Welfare; Clinical Center opens.

1955 Three Divisions formed—Biologics Standards, Research Services, and Business Operations. National Microbiological Institute becomes National Institute of Allergy and Infectious Diseases.

1958 Division of General Medical Sciences created.

1959 Office of Administrative Management formed, consolidating the Division of Business Operations and other managerial responsibilities.

1962 Division of Research Facilities and Resources created; National Institute of Child Health and Human Development established; Division of General Medical Sciences becomes National Institute of General Medical Sciences.

1965 Division of Computer Research and Technology established.

1966 Division of Regional Medical Programs established.

Directors of the National Institutes of Health

Joseph J. Kinyoun, M.D.
1887 – 1899

Milton J. Rosenau, M.D.
1899 – 1909

John F. Anderson, M.D.
1909 – 1915

George W. McCoy, M.D.
1915 – 1937

Lewis R. Thompson, M.D.
1937 – 1942

Rolla E. Dyer, M.D.
1942 – 1950

William J. Sebrell, M.D.
1950 – 1955

James A. Shannon, M.D.
1955 – ——

Historical Note

THIS INSTITUTE is dedicated to investigation of matters pertaining to the PUBLIC HEALTH.
In the year 1887 a bacteriological laboratory was established in the Marine Hospital, New York City. Four years later the laboratory was transferred to Washington and quartered with administrative offices at New Jersey Avenue and B Street, Southeast. In 1901 the Congress appropriated $35,000 for a building for the Hygienic Laboratory which was erected at Twenty-fifth and E Streets, Northwest, on land acquired by transfer from the Navy Department. The establishment on that site was enlarged by one building authorized by Congress in 1918, and by two buildings authorized in 1930. In the latter year by act of Congress, the name was changed to THE NATIONAL INSTITUTE OF HEALTH.
In the year 1935, Mr. and Mrs. Luke I. Wilson of Bethesda, Maryland, donated a tract of land to the United States Government for the use of The National Institute of Health. In the following year funds were allocated for the construction of buildings on this site. Work was begun on the first three buildings of this group in 1938.

Commemorating the dedication of the National Institutes of Health administration building is the following historical statement, inscribed on a bronze plaque just inside the main entrance:

This institute is dedicated to investigation of matters pertaining to the public health.

In the year 1887 a bacteriological laboratory was established in the Marine Hospital, New York City. Four years later the laboratory was transferred to Washington and quartered with administrative offices at New Jersey Avenue and B Street SE. In 1901 the Congress appropriated $35,000 for a building for the Hygienic Laboratory, which was erected at 25th and E Streets NW., on land acquired by transfer from the Navy Department. The establishment on that site was enlarged by one building authorized by Congress in 1918, and by two buildings authorized in 1930. In the latter year, by act of Congress, the name was changed to "The National Institute of Health." [1]

In the year 1935, Mr. and Mrs. Luke I. Wilson of Bethesda, Md., donated a tract of land to the U.S. Government for the use of The National Institute of Health. In the following year funds were allocated for the construction of buildings on this site. Work was begun on the first three buildings of this group in 1938.

[1] In 1948 the name National *Institutes* of Health was made official by another act of Congress.

Growth and Progress

At the beginning of this century, the average newborn child in the United States could be expected to live only 47 years. Today the average life span is 70 years. One of the reasons for this gain has been the progress of medical science, particularly against the infectious diseases.

Among agencies contributing to this progress has been the Public Health Service. Since its creation by Congress in 1798, this organization—first named the Marine Hospital Service—has shouldered a steadily increasing responsibility. Today its various services and facilities, such as those of the National Institutes of Health, form an important part of the Nation's public health resources.

The Service has conducted medical research since 1887, when a laboratory of bacteriology was established on Staten Island, N.Y. This was in response to the urgent need to guard against epidemics that might arise from persons entering the country. Dr. Joseph J. Kinyoun, director of the new laboratory, was the first to detect the cholera organism among immigrants to America.

The leading causes of death at that time were infectious diseases—pneumonia and influenza, tuberculosis, intestinal disorders. But those were also the days of Pasteur, Koch, and Ehrlich. They were days of discoveries that offered not only effective health weapons, such as diphtheria antitoxin, but also basic principles that launched an era of great progress in medical science.

The Public Health Service's laboratories, now centered largely in the National Institutes of Health at Bethesda, Md., have made many research discoveries of importance in the prevention and treatment of diseases and other disabling conditions. Illustrative discoveries are: recognition that pellagra results from a dietary deficiency; development of a vaccine and serum against Rocky Mountain spotted fever; demonstration that one type of cancer (choriocarcinoma) can be suppressed by chemotherapy; development of a technique for detecting abnormal openings between the left and right chambers of the heart; and the discovery of several diseases—ariboflavinosis, Louisiana pneumonitis, rickettsialpox. Most recent discoveries are: the discovery, test and treatment for the exact chemical cause of galactosemia; a practical and accurate diagnostic test for phenylketonuria; conclusive identification of the enzymatic block in histidinemia; proof that maleria can be transmitted from monkey to man; and an effective emergency treatment for burn shock so simple it can be made in any kitchen.

In 1962, NIH scientists succeeded in partially cracking the so-called genetic code which lies at the heart of the systematic reproduction of all living matter, and unraveled the first clue as to how genetic information is transmitted. Their work is of major importance because a full understanding of genetics is one of the most important basic problems in biology. This new knowledge of ribonucleic acid brings science closer to understanding the basis of life itself.

Research in metabolism, though often applied to a specific health problem, is gradually building toward an overall view of body chemistry. For example, much progress has been made in mapping the numerous

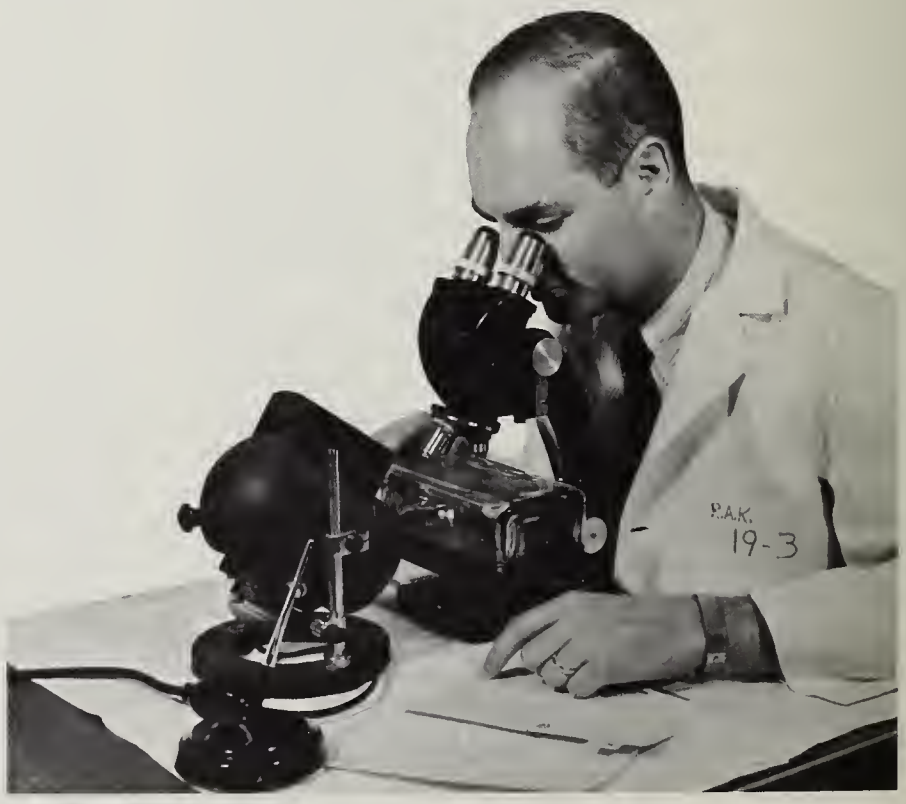
steps by which sugar in the body is converted to a usable form and finally burned to yield energy. Then, the means by which energy is harnessed are also being investigated. Such mechanisms involve vitamins, minerals, enzymes, and other substances. Intricate indeed is the jigsaw puzzle of metabolism, normal and abnormal; and a complete solution, certainly far in the future, would leave few mysteries of disease.

Biophysics, the science of matter and motion as related to life, is another expanding discipline that serves many fields. Again, new equipment and techniques have played a major part. For example, the electron microscope, about 100 times as powerful as earlier instruments, has extended the visualization of tissues to their smallest units, the molecules themselves. The ultracentrifuge, a high-speed whirling device, separates the particles composing cells. Other instruments that have opened new approaches are generators of subatomic particles in the multimillion-volt range, and brain-scanning equipment which permits detection and precise location of brain tumors without opening the skull.

Before World War II, major trends were apparent in the Nation's health. Sanitation, better nutrition, improved medical treatment had all contributed to longer life; and more people were subject to the ills of an aging population—the so-called chronic diseases. Their control would require new knowledge, new basic principles that only research could provide.

Accordingly, Congress authorized in 1937 the National Cancer Institute, dedicated to research against the disease that had risen from eighth to second place as a cause of death in this country. By 1950, the scope of investigation had been extended to include six additional research Institutes at Bethesda, some incorporating older laboratories, each to work in a problem area such as heart diseases or mental illness.

The most recent additions to NIH are the Division of Computer Research and Technology, established in 1965, and the Division of Regional Medical Programs, established in 1966. The mission of the Division of Computer Research and Technology is to conduct an interdisciplinary effort directed toward exploring and exploiting the potential for greatly accelerated advances in biomedical research through the concepts and methodology of mathematics and computer technology. The prime purpose of the Regional Medical Programs is to provide the medical profession and medical institutions greater opportunity to bring the latest advances in diagnosis and treatment of heart disease, cancer, and stroke to their patients.



National Institutes of Health Today

SINCE World War II, the National Institutes of Health has been part of a national trend toward more emphasis on research and development in all fields.

Throughout this period of growth, research in the life sciences has more than kept pace and now accounts for about 9 percent of the total.

A breakdown of the sources of support of medical and related research shows—as is true with all research and development in the United States—that Federal programs have contributed the major share in supporting this expansion. Of the estimated 1.9 billion dollars spent on medical research during fiscal year 1965, the Federal Government contributed 64 percent. Today, seven Federal agencies conduct or support medical research or fundamental research related to medicine. They are: Department of Health, Education, and Welfare; Department of Defense; Atomic Energy Commission; Veterans Administration; National Science Foundation; Department of Agriculture; and the National Aeronautics and Space Administration.

The Depatrment of Health, Education, and Welfare is responsible for over seven-tenths of the Federal expenditure for medical research. About 85 percent of the Department's appropriations for medical research are invested in Public Health Service programs conducted and administered by the National Institutes of Health.

A predominant part (in fiscal year 1965, about 80 percent) of the public funds appropriated for NIH is in turn awarded to non-Federal institutions such as medical schools and colleges, universities, hospitals and scientific institutions for the support of research studies, research training, and the construction and equipping of new and modernized research facilities. This is often referred to as the extramural program.

Research project grants constitute the largest part of the extramural program. The purpose of these grants is to stimulate research in medical and allied fields by making available funds for such research and by actively encouraging scientific investigation of specific problems on which scientists agree that urgently needed knowledge is lacking. Since its inception in 1946, the research grants program has operated under a basic tenet that the integrity and independence of the research worker and his freedom from control, direction, regimentation, and outside interference are paramount. Initially, it was possible to provide support to investigators on a year-to-year basis only. Through the years, however, the promised period of support given to investigators starting a new project has increased gradually to an average of more than 3 years. Thus, the recipient of a new grant today has greater assurance of stability in planning a program of research. In fiscal year 1965, a total of 16,372 of these grants were awarded to scientists in non-Federal institutions.

Although the research projects supported by NIH-administered grants provide secondary training benefits in a research atmosphere, the support of research training and related activities is a distinct and separate part of the extramural program. These efforts do not constitute the primary source of funds for the training of doctors, dentists, nurses, and medical scientists, but

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rather serve to supplement the sums provided by State and local governments, by private philanthropy, and by the families and friends of the students themselves. There are four basic types of support for the training of research personnel: (1) Research Fellowships; (2) Research Career Awards; (3) Traineeships, and (4) Training Grants. There were about 10,875 awards (new and continuation) made in fiscal year 1965.

Fellowships provide personal support, and in some instances provide for certain additional costs, for persons engaged in research training at one level or another.

Training grants are mainly for the purpose of assisting institutions to establish, expand, or improve their research and special training programs and to increase the number and improve the caliber of trained personnel in fields of major interest to the various Institutes.

Traineeships provide stipends in order that individuals may undergo training in specialized areas of medical and related research and technology, including the fields of public health and nursing.

Another major activity of the extramural program provides grants on a matching basis to public and private nonprofit institutions to assist in the construction of additional facilities for the conduct of research in the sciences relating to health. In the more than 9 years following passage of the Health Research Facilities Act of 1956, 1,328 grants totaling more than $361 million have been made to 402 institutions in 50 States, the District of Columbia and Puerto Rico.

To assure that the direction and method of operation of the grants and awards programs are in the national interest, NIH relies on advisory and consultative groups to the Public Health Service. These groups, consisting of some of the Nation's leading scientists and informed, public-spirited citizens, provide study and advice which is an inherent part of the philosophy that NIH grants and awards programs are of and for the scientific community and in behalf of the people of the United States.

For example the Study Sections—which numbered 59 in 1965—are composed of specialists who represent the disciplines that comprise modern medical science. These Sections, composed of non-Federal specialists, screen each grant application to ascertain the qualifications and competence of the investigators, adequacy of the research findings, significance of the proposed study, and the relative importance of particular areas of research.

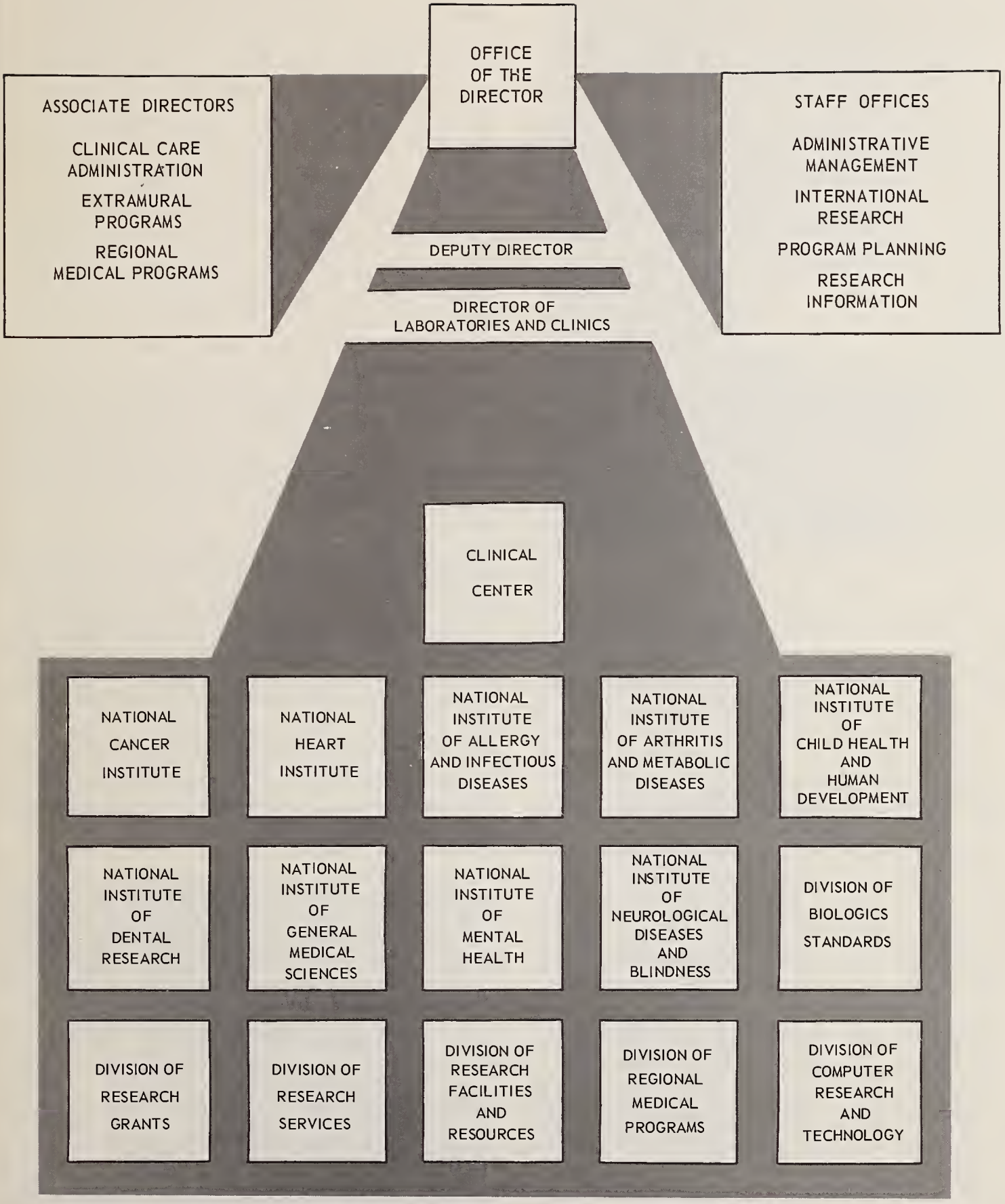
Each Study Section reaches its decisions objectively and submits its professional recommendations to a second group of advisory bodies—the National Advisory Councils. Statutory rather than administratively established, the Councils are composed of both scientists and representatives of other professions. There are 11 Advisory Councils; one for each of the 9 Institutes at NIH, the National Advisory Council on Health Research Facilities, and the National Advisory Health Council, which reviews applications for general research support grants, and advises on broad aspects of public health. The Surgeon General of the Public Health Service may not approve a grant application that has not been recommended by an Advisory Council.

A third type of advisory body was created at NIH in 1957. These groups, called Boards of Scientific Counselors and composed of six non-Federal scientists, advise each of the Institutes and the Division of Biologics Standards on the scientific activities conducted directly in the clinical and laboratory facilities of NIH.

At Bethesda and in its field facilities, the NIH staff numbers over 11,000 full-time workers, including over 1,700 with doctoral degrees. Of these, slightly more than half are M.D.'s, and most of the remainder are Ph.D.'s. In addition, nearly 10 percent of the physicians at NIH also have a Ph.D. or other doctorate. The scientific staff also includes dentists, veterinarians, and doctors in other sciences. In its own laboratories, the National Institutes of Health conducts more than 1,400 research projects. They cover many areas that can be specifically identified with the diseases for which the Institutes were named, but a substantial number of studies deal with fundamental body processes essential to basic understanding of disease and health.

Top program direction and coordination are provided by the Director of NIH, his professional staff associates for guidance of the intramural and extramural programs, and staff aides for administration, international research, program planning, and research information. The Office of the Director works with the Institute Directors, Scientific Directors, and others in the Institutes and Divisions to coordinate and evaluate the research and support programs.

In summary, then, the National Institutes of Health serves primarily as a focal point for the national support of health research and secondarily as an institution which, in itself, conducts a wide variety of laboratory and clinical research aimed at discovering new knowledge about the prevention, diagnosis, and treatment of disease and disability.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CLINICAL CARE ADMINISTRATION
EXTRAMURAL PROGRAMS
REGIONAL MEDICAL PROGRAMS
STAFF OFFICES
ADMINISTRATIVE MANAGEMENT
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PROGRAM PLANNING
RESEARCH INFORMATION
DEPUTY DIRECTOR
DIRECTOR OF LABORATORIES AND CLINICS
CLINICAL CENTER
NATIONAL CANCER INSTITUTE
NATIONAL HEART INSTITUTE
NATIONAL INSTITUTE OF ALLERGY AND INFECTIOUS DISEASES
NATIONAL INSTITUTE OF ARTHRITIS AND METABOLIC DISEASES
NATIONAL INSTITUTE OF CHILD HEALTH AND HUMAN DEVELOPMENT
NATIONAL INSTITUTE OF DENTAL RESEARCH
NATIONAL INSTITUTE OF GENERAL MEDICAL SCIENCES
NATIONAL INSTITUTE OF MENTAL HEALTH
NATIONAL INSTITUTE OF NEUROLOGICAL DISEASES AND BLINDNESS
DIVISION OF BIOLOGICS STANDARDS
DIVISION OF RESEARCH GRANTS
DIVISION OF RESEARCH SERVICES
DIVISION OF RESEARCH FACILITIES AND RESOURCES
DIVISION OF REGIONAL MEDICAL PROGRAMS
DIVISION OF COMPUTER RESEARCH AND TECHNOLOGY

National Cancer Institute

EVERY YEAR, about 870,000 people in the United States are treated for cancer; some 570,000 of these cases are newly diagnosed. Approximately 300,000 cancer deaths occur annually in this country, or one in every six deaths from all causes.

Cancer is a disorder in which cells grow and spread abnormally. Once cells become cancerous, they retain their new form and reproduce rapidly. They take food needed by normal cells, attack healthy tissues, and spread from their original site to other parts of the body. There are scores of different forms of cancer, and it seems likely that many factors play a role in causing each one. As a result, the effort to bring cancer under control is confronted by many problems.

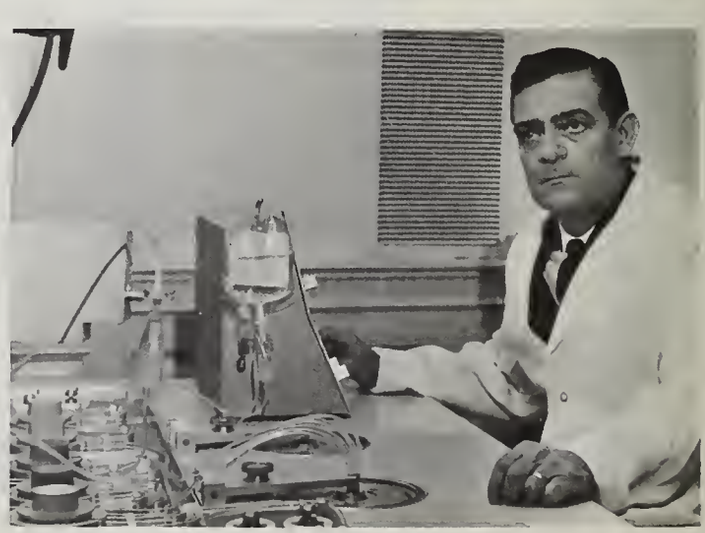
The National Cancer Institute is a leader in the worldwide effort to solve these problems, through research on the nature, causes, diagnosis, and treatment of cancer.

Established by an Act of Congress in 1937, the Institute is the oldest of the nine institutes and six divisions that make up the National Institutes of Health. About 600 scientists, physicians, technicians, and laboratory assistants carry on basic research in biology, biochemistry, viral oncology, viral carcinogenesis, pathology, pharmacology, and physiology, and clinical investigations in endocrinology, medicine, surgery, radiology, dermatology, and immunology. The Institute has laboratories in several buildings on the NIH grounds and both laboratory space and hospital beds in the Clinical Center for coordinated research and treatment.

Through grants and awards to investigators at other institutions in this country and abroad, the Institute supports additional research on virtually every aspect of cancer. Currently about 2,000 research grants are in effect. The Institute also provides funds to train scientists in cancer research and teaching, and to alert physicians to advances in diagnosis and treatment.

The blood cell separator, shown below, was developed by the National Cancer Institute in cooperation with the International Business Machines Corporation to automate the separation of blood components into three main fractions—plasma, red blood cells and white blood cells. This instrument is expected to help fill the need for a rapid, efficient and safe method of separating and collecting quantities of normal human blood components required in the treatment of leukemia.

The instrument operates on the principle that blood components have different densities when spun at relatively low speeds in a centrifuge. It is also capable of being used on a continuous-flow basis, channeling blood from a donor into the separator and back to the donor after removal of certain components needed for transfusion.



These programs of support for research and training account for more than half of the funds Congress appropriates each year for the Institute.

Since the control of cancer requires the development of practical means for preventing the disease as well as for treating it, studies in carcinogenesis (cancer causation) are an important part of the program of the National Cancer Institute. This is an old area of cancer research, for the influence of excessive exposure to sunlight, X-rays, radium, and certain coal tar products was recognized long ago.

Some current carcinogenesis studies conducted or supported by the Institute are assessing the potential hazards of air and water pollution, cigarette smoking, radioactive materials used in industry, and the widespread use of pesticides and food additives. Many of these are laboratory studies of suspect cancer-causing agents; but others are statistical investigations of variations in the occurrence of some forms of cancer in relation to race, age, sex, marital status, living habits, occupation, and place of residence of specific population groups.

In research on the causes of cancer, the role of viruses is becoming increasingly important. Since viruses are known to cause cancer in several animal species, many scientists believe there is a strong possibility that they may be responsible for certain forms of human cancer as well. If this proves true, it may be possible to prevent such cancers by developing vaccines or by chemically modifying the effects of viruses.

Institute virus-cancer research was accelerated recently by the launching of a special program on viruses and leukemia. Besides investigating the cause, treatment, and prevention of human leukemia, the new program covers the nature of animal leukemias and their possible relation to man, and the control of hazards in virus-cancer research. About 180 projects are involved, carried out under contract and at the Institute.

Many of the scientists helping to carry out these projects are members of the Institute's Acute Leukemia Task Force. This group of Federal and non-Government medical investigators has been cooperating, for a number of years, in studies of many aspects of the disease including the role of viruses in the causation of leukemia and in the development of improved methods of treatment and general care of the patient.

To date, six drugs have been found which can completely—though temporarily—control acute leukemia. These drugs have been developed through research on drug treatment which is another major part of current cancer investigations. Surgery and radiation

A laboratory technician at the National Cancer Institute holds a Japanese quail used in virus-cancer research. The Rous sarcoma is injected into the ring web of the quail and the resulting tumors studied. Embryonated Japanese quail eggs also are injected with viruses which induce tumors and other diseases. These studies are part of the intensified effort to determine the possible role of viruses in the induction of cancer in man.

therapy are the only means of curing most forms of cancer, but chemotherapy (drug treatment) offers the greatest hope for dealing effectively with generalized cancers, such as leukemia, or cancers that have spread beyond their original site.

Since 1955, the Institute has administered a nationwide cooperative program to find and bring into use new and more effective drugs. Thousands of compounds are screened every year, and, after additional testing, the most promising ones are carefully evaluated in clinical trials in hospitals across the country.

Institute scientists are active in chemotherapy research and much of their work is integrated with the national program. They are particularly concerned with drug treatment of patients with leukemias and lymphomas, such as Hodgkin's disease, and are working to improve control of the hemorrhage and infection that are constant dangers to leukemia patients.

Among other developments, they have adapted a transfusion technique to provide platelets, the blood elements needed to control bleeding, to leukemia patients.

The best results in chemotherapy have been the long-term control of choriocarcinoma, a rare form of cancer that develops in the uterus after pregnancy. National Cancer Institute scientists have shown that a high percentage of choriocarcinoma patients can now be freed of all evidence of this disease by drugs alone, a first in cancer chemotherapy.

Staff scientists and Institute grantees are also conducting many other studies, such as the effects of radiation on normal tissue and cancer, the use of animal tumor systems to predict the probable effects of drugs on human cancer, the possible use of the laser in cancer surgery, and the development of techniques for measuring the effects of cancer and treatment on the patient. Basic research to determine the nature of cancer and the process by which normal cells become cancerous include investigations of the relation of genetic constitution to the occurrence of various types of cancer, the role of nucleic acids, and the nutritional and chemical factors present in the cancer-causing process.

Some of these studies may prove applicable in the development of biochemical, biophysical, immunological, and cytological techniques for detecting early cancer—a prime target of research supported and conducted by the National Cancer Institute.

Among NIH studies are clinical investigations of compounds of promising potential for treatment of high blood pressure.

National Heart Institute

Diseases of the heart and blood vessels cause over half the deaths in the United States, almost 1 million each year. Heart diseases claim many victims prematurely, in their most productive years. Over 14 million Americans have cardiovascular ills.

To help combat this serious national problem, Congress in 1948 established the National Heart Institute. The Institute's intramural research program is directed primarily toward the acquisition of basic knowledge about the structure of the body and its functions. This offers the most promising approach for understanding the underlying causes of disease and for eventual means of prevention and cure.

At the same time—thanks to the excellent patient-care facilities provided by the NIH Clinical Center—the Heart Institute also conducts a vigorous research program aimed more directly at the solution of specific clinical problems posed by heart disease.

Here is a brief view of a few major areas of activity in the National Heart Institute:

Investigators in cellular physiology and metabolism are attempting to translate to a cellular or organ level the advances made in the general field of enzyme chemistry and biophysics. They are studying the way body cells use the chemical energy found in food for such processes as muscular contraction. The same laboratory is also studying the factors implicated in the development of atherosclerosis, the major form of hardening of the arteries.

The Institute's Chemical Pharmacology Laboratory seeks to acquire enough basic knowledge about the chemical structure of drugs to be able to predict what their effects will be in the human body. Such studies will provide pharmacologists with the facts they need to design drugs for the specific treatment of individual patients.

Institute research in clinical biochemistry is concerned with the mechanisms of metabolism and with disease-induced alterations in these mechanisms. A major area of study is the metabolism of amines. Since many drugs currently used against hypertension affect amine storage, synthesis, or destruction, scientists frequently employ drugs as research probes in the study of amine metabolism.

Research on the physiology of the kidney and on the mechanisms by which it maintains fluid balance, acid-base balance, and electrolyte balance in the body is a prime concern of NHI scientists. Other important studies are centered on the roles played by hormones from the pituitary, adrenal, and other endocrine glands as regulators and modulators of these processes.

In clinical endocrinology, scientists are conducting studies on the basic physiology of the adrenal cortex and parathyroid glands. Particular emphasis is given to research on the synthesis, release, and metabolism of aldosterone and on the role of parathyroid hormone in calcium and phosphorous metabolism.

Artificial heart valves and blood vessel replacement parts used by NHI heart research surgeons.

The research of investigators concerned with cardiovascular physiology is aimed at understanding the numerous regulatory mechanisms that adjust heart performance to conform with the circulatory requirements of the body's organs and tissues. Scientists are giving special attention to the nerve and hormonal pathways which can affect heart work and output.

Heart Institute surgeons are constantly exploring new methods for the surgical treatment of patients with congenital or acquired heart disease. They test new techniques in laboratory animals. Those that prove worthy are given clinical trials in patients. For instance, much progress has been made in the design and installation of artificial prosthetics for the partial or complete replacement of heart valves and blood vessels too severely damaged for restoration by surgery.

In addition to this fundamental laboratory and clinical research at Bethesda, another major Institute function is concerned with collaborative and epidemiological studies covering two broad areas. The first relates to the search for causes of heart disease in populations which show high susceptibility and contrasting populations relatively free from heart disease. This area is encompassed within epidemiology, geographic pathology, and community study operations, such as a long-term project at Framingham, Mass., to determine the characteristics of people who develop heart disease.

The second area involves the scientific alteration of "risk" factors (such as high blood pressure, cigarette smoking, and high cholesterol levels), found prevalent among people with heart disease. The purpose, for example, in studies seeking alteration of diet to maintain lowered cholesterol, is to determine measures effective in preventing the development of heart disease.

Other Institute functions include biometrics research and the collection and dissemination of public and professional information.

No single research facility, of course, could meet the problem of the conquest of heart disease. Heart research is carried on in hundreds of hospitals, universities, and other institutions all over the United States. In these research centers the Heart Institute supports more than 2,000 scientific projects through research grants. Support is also awarded to medical schools and other institutions and individuals to strengthen cardiovascular teaching, to encourage heart research careers, and to increase and improve training in fields important to progress against heart disease. Altogether, these extramural programs account each year for over three quarters of the annual appropriations to the National Heart Institute.

Today there is more to be learned before the great bulk of diseases of the heart and circulation can be conquered. So research is the major mission of the National Heart Institute program. Yet in every part of this program, research and the application of its results are intertwined . . . knowledge is sought, knowledge is shared, and people are helped.

Cholesterol, a fatty substance in the blood, is still a prime suspect in medicine's case against coronary heart disease.

National Institute of Allergy and Infectious Diseases

RESEARCH on infectious diseases, largely centered in the National Institute of Allergy and Infectious Diseases, is the oldest activity of the National Institutes of Health. Notable advances have been made against many serious infectious diseases, especially through development of new vaccines and antibiotics. But critical problems remain unsolved. For example, no drug has been found that is generally useful against viruses.

The National Institute of Allergy and Infectious Diseases is concerned with a formidable array of afflictions of mankind, such as German measles, asthma and hay fever, hepatitis, viral encephalitis, smallpox, streptococcal and staphylococcal infections, tuberculosis, rabies, malaria, and emphysema.

In its laboratories and clinical research facilities at Bethesda and at field stations in Montana, Hawaii, the Panama Canal Zone, and smaller units elsewhere, the Institute conducts some 200 research projects. Through the research grants program, it supports 2,000 additional studies mainly in non-Federal laboratories and medical centers throughout the United States and in some foreign facilities. Collaborative work is also conducted with other Government research groups and with industry and university medical center specialists.

Against bacterial infections, for example, the Institute and its grantees are constantly at work trying to develop new antibiotics, or new forms of these useful drugs, in order to maintain our control over microbes that can change their mode of attack all too soon after we change our defenses.

The allergic diseases, too, present a great challenge to medical science. These widespread and little-understood disorders are being studied especially from the standpoint of the basic immunologic processes involved in allergy and many other disorders.

Viral disease is another interest of the Institute, whose scientists continue to make major contributions to our understanding of viral illness, especially the host of respiratory infections and their serious complications. The comparison has been made that virology stands today where bacteriology stood in the early 1900's, holding great promise for the alleviation of many ills.

Still another strong interest is the parasitic diseases, including many of the so-called tropical diseases that tax world health and world economy. Malaria, for example, afflicts about 200 million people, kills 2 million a year, represents a constant threat to every world traveler, and is a barrier to economic development in the emerging nations of Africa, South Asia, and parts of Latin America.

The success of medical science in freeing the people of the United States from many infectious diseases has enabled this Nation to become a world leader in the research attack against these afflictions. At the same time, we have been able to focus more attention on the so-called chronic diseases about which you will read more later in this brochure.

Scientists and physicians have also become aware of relationships of infections to chronic disorders. For example, streptococci are involved in rheumatic heart damage. The knowledge that viruses cause certain types of cancer in animals has led to a search for possible human cancer viruses. Future progress against many chronic diseases may arise from more effective control of infections in the earliest years of life.

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In respiratory virus research, Institute scientists and grantees have been leaders in the field. They have discovered and defined many of the new viruses now related to acute respiratory illness. Adenoviruses, parainfluenza and respiratory syncytial viruses, and the *Mycoplasma pneumoniae* organism (the so-called Eaton agent) are now implicated in a major proportion of severe respiratory infections in children and young adults.

Three national programs are being directed by the Institute: the Vaccine Development Program, the Viral Reference Reagent Program, and the Tissue Transplantation-Immunology Program. The first has as its objective the development of vaccines against some of the newly recognized respiratory diseases often grouped by laymen under the term "common cold." The second is designed to provide research workers with standardized and comparable viral reference reagents—that is, substances that react with a virus to identify it. The transplantation program is aimed at finding ways of overcoming the final, immunologic barrier to successful organ transplantation: tissue rejection. Its goals include techniques for matching donors and recipients of organs in much the same way that blood donors and recipients are now matched.

The biochemical and biophysical structure of viruses also is being investigated by the Institute, as is the structure of other microbes and of human cells. The vectors or carriers of disease organisms also are studied intensively in the hope of finding a "weak link" in their metabolism or life cycle.

Modern techniques are being used to study the immunologic aspects of such diseases as lupus erythematosus, myasthenia gravis, and others in which an autoimmune mechanism is suspected—that is, the immune response of an individual hypersensitive to materials present within his own body.

One of the historic components of the Institute is the Rocky Mountain Laboratory, created in 1921 to study Rocky Mountain spotted fever, against which Institute scientists some years later successfully produced a vaccine. This laboratory at Hamilton, Mont., has become a world center for the study of diseases in nature that can be transmitted to man.

The Institute also supports a laboratory, the Middle America Research Unit in the Canal Zone, and interrelated facilitics at Bethesda, concerned primarily with tropical virology, especially viral infections transmitted by mosquitoes, mites, and other arthropods.

Since the first admission of patients in 1953, Institute clinicians have accumulated an impressive and in many cases unique series of cases of hypogammaglobulinemia (failure to produce sufficient antibodies against infection), cystic fibrosis, disseminated lupus erythematosis, and systemic fungal disease. Most recently a program to study acute respiratory illnesses in adult patients is providing new information about human response to these infections. Special clinic-laboratory facilities have made it possible to test several new drugs that show promise against bacterial and fungal diseases that resist known treatments.

Looking ahead, the Institute plans to intensify its efforts to develop new or improved vaccines against whooping cough, typhoid fever, tuberculosis, and German measles. It will also expand its search for more knowledge about the role of viruses and other microbes in chronic diseases, such as emphysema, arthritis, multiple sclerosis and other degenerative neurological disorders. More work will be done to find new or improved drugs to combat resistant forms of bacterial and protozoal infections, as well as antiviral drugs to control some infections at their onset.

Mouse lungs are weighed before microscopic examination to measure the protective effect of a new experimental vaccine against tuberculosis.

National Institute of Arthritis and Metabolic Diseases

MOST PEOPLE will either develop some form of arthritis during their lifetime or know someone who does. This disease, which is probably responsible for more crippling and discomfort than any of the other ills of man, is one of the major research interests of the National Institute of Arthritis and Metabolic Diseases. Here, as in other research centers throughout the country, the intensive studies now undertaken on arthritis and other rheumatic diseases are in sharp contrast to those of a few short years ago when relatively little research was being done.

Although ostensibly established for the study of the arthritic disorders, and diseases of metabolism such as diabetes, the Institute has continued to expand its activities in other major research areas. These now include diseases of the gastrointestinal tract such as peptic ulcer, many hereditary disorders such as cystic fibrosis, endocrine gland diseases, blood, liver, and bone disorders, urology and diseases of the kidney, orthopedics, and dermatology.

Congress created the National Institute of Arthritis and Metabolic Diseases in 1950, following a surge of interest in the arthritic disorders, spurred in part by the discovery that the then recently synthesized adrenal hormone, cortisone, could bring dramatic relief to many victims of arthritis. Since then, Institute and Institute-supported scientists have investigated and tested newer and safer synthetic corticosteroid drugs, as well as nonsteroid agents, in the treatment of rheumatoid arthritis and allied disorders.

Recent efforts directed at uncovering the environmental and genetic aspects of rheumatic diseases promise to provide much needed basic information about the causes of these disorders. The concept that some of the rheumatic diseases may be caused by hypersensitivity, that is, abnormal sensitivity by rheumatic patients to specific components of their own tissues, has been further strengthened by studies in both animals and man. Institute and Institute-supported scientists are also studying the possibility that an infectious agent may be responsible for causing an alteration in components of their own tissues and in the immunity mechanism, resulting in the disorder. Some of these scientists are involved with studies of mycoplasma, extremely small, and as yet incompletely studied micro-organisms with properties lying somewhere between viruses and bacteria, which have been implicated in the causation of rheumatoid arthritis.

In still another approach to the cause of rheumatoid arthritis, an epidemiological study by an Institute field unit has shown that the occurrence of this disease is not tied to hereditary factors but may well be influenced by environmental factors other than climate. In studies on two widely-contrasting tribes of American Indians living in opposite extremes of climate, the Blackfeet of Montana and the Pimas of Arizona, the prevalence of arthritis showed a decidely random pattern, uninfluenced by blood relationships or climate.

An unexpected byproduct of this field study revealed that the frequency of diabetes among the Pima Indians is the highest ever reported in any circumscribed population group. This finding has led Institute scientists to initiate more intensive studies which would include exploration of the possible precipitating factors as well as factors involved in the prevention or postponement of development of the serious complications of this disease.

Another finding involving both the arthritic and

One therapy for rheumatoid arthritis includes exercises and casts. To straighten this little girl's bent leg, graduated casts at left were put on first; the new cast indicates her progress.

metabolic disease field dealt with osteoporosis, a "bone-thinning" disease marked by long continuing mineral loss from, and resultant weakening of, the skeleton. Institute researchers have found that diets high in calcium may offset further bone-thinning in patients suffering from this disorder, as well as in rheumatoid arthritis patients who are being treated with corticosteroid drugs and who are known to lose calcium as a result of this treatment.

Other Institute findings include the cause of a blood disease, neonatal thrombocytopenic purpura, which occurs in infants, shown to be due to blood platelet type differences between mother and offspring, and the finding that oral administration of ordinary table salt and baking soda in water is a simple and effective method of emergency treatment of shock due to burns.

Diseases of metabolism involve inherited or acquired defects which interfere with specific steps in the chemical processes which must go on in the body for normal life. Research in diabetes, perhaps the best known and most important of the metabolic diseases, has been stimulated by the discovery of the oral antidiabetic drugs. Among other research in diabetes, Institute scientists are studying insulin antagonism, the likelihood that in some patients diabetes may be caused by substances which interfere with the action of insulin, and are investigating prediabetes, that stage in a potential diabetic's life before he develops any of the early signs of the disorder.

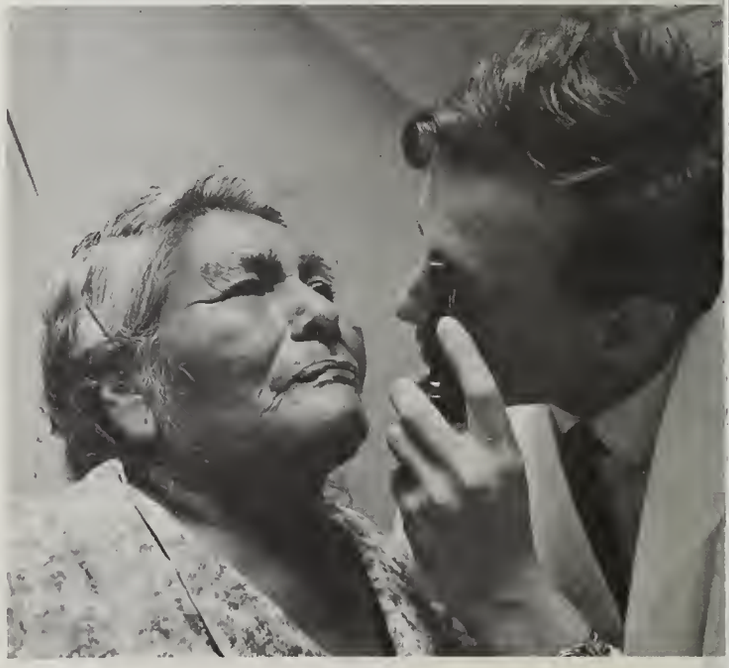
Although many medical advances have come from clinical research alone, many others have resulted from biological, chemical, and physical investigations into the fundamental structure, functions and reactions of living tissues and systems in health and disease, sometimes categorized as "basic research." The variety of studies in this area is mirrored in such developments as the dramatic partial "cracking" of the genetic code by Institute scientists, an accomplishment that provides new knowledge of the machinery of heredity, and the synthesis of a valuable analgesic drug, phenazocine.

In the field of kidney disease, the Institute is involved in an all-out attack upon the problems of chronic uremia (the fatal end stage of kidney failure), hemodialysis (blood purification with the aid of an artificial kidney), and improvements in artificial kidney technology—areas of research which directly affect thousands of Americans suffering with kidney disorders. A problem receiving much attention is finding ways to simplify the methods and reduce the cost of artificial kidney treatment for patients with chronic kidney failure.

Increasing awareness of certain childhood disorders has led the Institute to conduct intensive studies on cystic fibrosis, an inherited, grave, generalized disease of unknown cause which is now recognized more frequently in surviving adults.

A major activity of the Institute is its large extramural grants program which supports biomedical research of similar nature at universities and medical centers throughout the country. This program also includes provision of fellowships and training grants to develop research talent to carry on studies of the causes, diagnosis, and treatment of the diseases within the area of responsibility of the Institute.

Epidemiologist examines woman during field study of diabetes among Pima Indians of Arizona. Continuing studies may provide additional clues to the causes of diabetes.



National Institute of Child Health and Human Development

Established in January 1963, the National Institute of Child Health and Human Development made possible within the National Institutes of Health a concentration of research efforts on the total process of human development—from before conception through the prenatal period, infancy, childhood, adolescence, maturity, and old age.

The goal of the Institute is insight into normal growth and development. It accomplishes this through research and training aimed at understanding of the processes on which the health of both children and adults depends.

The Institute is interested in the special health status of certain segments of the population—infants, expectant mothers, adolescents, aged persons and the mentally retarded—on which intensive study is needed.

In working to achieve its goal, the National Institute of Child Health and Human Development concentrates its efforts in four major program areas: (1) the Reproduction Program is concerned with clinical, biological, and behavioral aspects of animal and human reproduction; (2) the Growth and Development Program deals with physical, intellectual, social, and behavioral development in the period from birth to full maturity; (3) the Aging Program is concerned with the biological, behavioral, and social aspects of aging including the progressive changes that take place in cells, tissues, organ systems, individuals, or groups of individuals; (4) the Mental Retardation Program is concerned with all aspects of retardation from biomedical, behavioral, and social points of view.

The study of child health includes frequent checkups during the formative years, and from facts learned in this research come new clues concerning normal human development.

To provide maximum coordination, all research and training activities in each of these fields are under the administrative supervision of a highly-qualified program director. This single focal point permits identification of trends, gaps, and progress, making possible more pertinent intensified research.

The Institute sponsors and supports research by investigators in universities, research centers, and medi-

cal schools throughout the United States and in foreign countries.

The Institute supports studies in the biological and physiological aspects of reproduction; fetal growth and development, the development of the embryo, gestation, and the physiology of the uterus and placenta; the growth, development and physiology of the reproductive organs; genetics, comparative anatomy, and physiology and biochemistry as related to problems of child health and human development.

Other studies cover the prenatal and perinatal period of human development; obstetric and pediatric problems, the labor process and delivery; the physiological adaption of the newborn infant; prematurity, respiratory distress of the newborn; obstetrical problems involving maternal health; toxemia of pregnancy, lactation, and maternal-newborn behavioral relationships.

Studies also investigate factors affecting growth and development; factors causing abnormal development, such as mental retardation, congenital malformations, and inborn errors of metabolism; the normal development of physiologic systems, normal intellectual development, determinants of intellectual excellence; nutrition and body composition; the process of maturation; and social and behavioral aspects of development.

The Institute supports basic studies on the biological and behavioral aspects of aging; the root processes of aging, including studies of metabolism and nutrition; physical and environmental factors influencing the aging process; studies of the total life span, beginning before birth and extending through childhood, adolescence, middle age and old age.

In all program areas, normal and healthy subjects are given attention as well as abnormal and pathological. Animals, particularly subhuman primates, are targets of some Institute-sponsored observations.

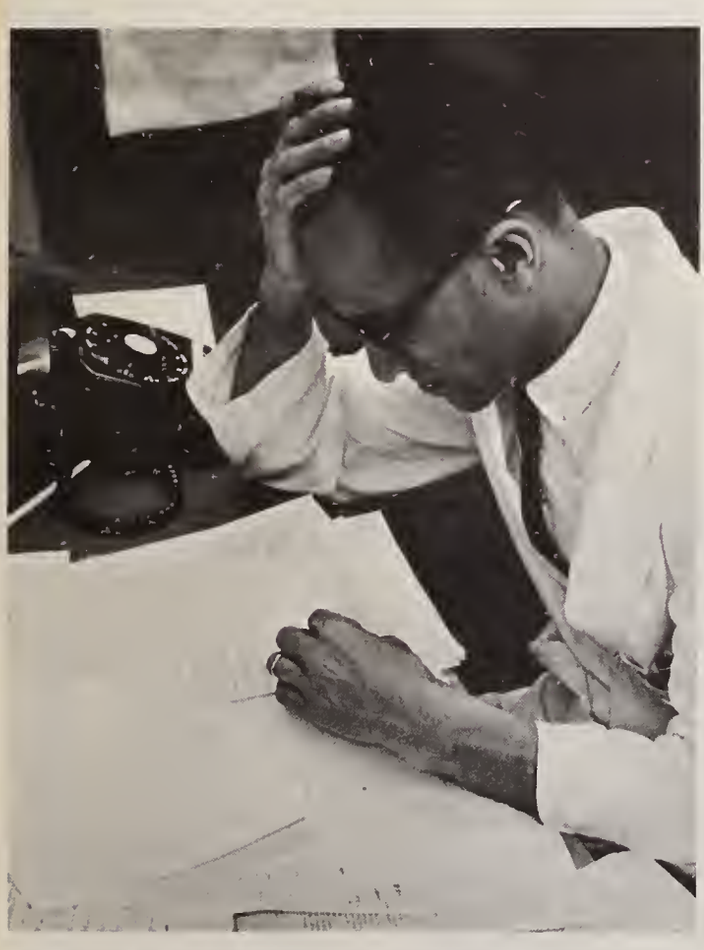
The Institute places special emphasis on training programs, through which it hopes to increase the national supply of trained scientists, teachers and physicians in the basic and clinical sciences related to human development. These programs are designed to improve the quality of training now available, and to increase opportunities for promising young scientists and established investigators to pursue careers in medical research.

The Institute is developing research training programs especially for pediatricians, obstetricians, and other investigators interested in careers in developmental biology, various aspects of child development, reproduction, teratology, and senescence. The Institute also supports cross-disciplinary research training, such as pediatric training for neurologists, the behavioral science training for pediatricians, to deal with special childhood problems.

The National Institute of Child Health and Human Development, through this support of research and training, encourages imaginative investigation of the complex problems of human development, from conception to old age, and the basic processes of life. On this foundation, a concentrated, national attack on the causes of many remaining threats to health of both children and adults can be mounted.

The years from childhood to old age form the patterns of human development. The developmental process is part of life and research is the path to understanding it.

National Institute of Dental Research



Research papers published by the Dental Institute's professional staff represent a wide range of fields of science in biology, medicine, and dentistry. Over a recent 10-month period, the staff of 83 investigators contributed 131 original research papers to 50 different scientific journals.

THE NATIONAL INSTITUTE OF DENTAL RESEARCH singularly personifies the interrelatedness of the biomedical sciences. Although concerned primarily with aberrations of a single site, the oral cavity, the Dental Institute is necessarily involved in basic research probing the very life processes and the nature of disease. Only through fundamental research of this type has it been possible to achieve a greater understanding of the etiology of the complex oral disorders. Such research, bringing together a wide variety of scientific disciplines, holds the key to the further reduction and ultimate prevention of these problems, which, in one form or another, affect practically every American.

Not surprisingly, findings from Dental Institute studies often transcend oral health problems and have therapeutic implications for other pathologic conditions. Likewise, the Dental Institute serves as a broad resource of competence, particularly in the genetics field and in the use of germfree research techniques.

A multipronged approach is directed to the universal problem of tooth decay. Current research emphasis derives from the hypothesis that three factors act in conjunction to produce caries: the tooth must be susceptible; specific bacteria must be present in the mouth; and the diet must be high in fermentable carbohydrates, such as sugar, which are broken down by bacteria into decay-producing substances.

Early epidemiologic studies which established the caries-inhibiting effect of one part of fluoride per

million parts of water have led to the greatest preventive measure in dental history. Children in communities with fluoridated water supplies have 50 to 65 percent less tooth decay, and this protection extends into adult life.

Germ-free animal research has produced some significant leads on the role of bacteria in dental decay. Specific strains of streptococci which produce decay in the hamster and in the rat have been identified. Bacterial strains which will induce caries in the hamster and in the rat have also been isolated from human carious teeth. But the all-important question of whether caries is transmissible in man, as it is in certain animals, remains unanswered.

In nutrition studies, biochemists seek information as to how contact of various types of food with the teeth influences decay. Preliminary evidence suggests that phosphates hold promise for effectively reducing caries by changing the bacterial action on carbohydrates in the diet.

Utilizing modern techniques, recent research has corroborated the results of these pioneering studies by demonstrating that fluoride reduces caries by combining with the structure of the tooth to make it more resistant to decay. More precise knowledge as to how fluoride inhibits caries is emerging from biophysical studies of the process of calcification. Through X-ray diffraction and electron microscopy, much information has been developed on the ultrastructure of teeth, the crystals comprising the enamel, and the dimensions of these crystals.

Related studies have shown that fluoride induces a favorable change in crystallinity of bone structure. Current emphasis is being given to the application of this finding to the treatment of periodontal disease by inhibition of alveolar bone resorption.

Other studies of periodontal disease—the major cause of loss of teeth in adulthood—are many-faceted. For example, Institute epidemiologists, in worldwide studies, have shown that nutrition, altitude, climate, and other factors are irrelevant. The one common causative denominator is poor oral hygiene.

A condition similar to periodontal disease can be caused in hamsters by a filamentous microorganism. Inoculation with the organism produces periodontal disease in the hamster, and the condition can be transmitted from an infected animal to an uninfected animal.

Other research includes studies of the mechanisms of calculus formation, enzyme systems in normal and diseased tissues, and the processes of maturation of collagen, the most important component of connective tissue. While these basic research studies focus on the cause of periodontal disease, clinical efforts are directed toward therapy and prevention.

Several professional disciplines are represented in a multidisciplinary approach to physiological studies of laryngeal and pharyngeal anatomy and function in children, and cleft palate patients with speech and feeding disorders. These studies are directed at physiological and psychological adaptations to oral-facial birth defects, differences in respiratory, masticatory, and speech mechanisms, and criteria for surgical and prosthetic management.

Institute laboratory research in this area concentrates on the induction of malformations in animals by drugs or by changes in the intrauterine environment and the elucidation of the embryologic and biochemical mechanisms involved.

Another important area of study encompasses heritable diseases of the oral cavity, genetics of selected population groups, and the genetics of chromosome and gene behavior.

The Institute encourages clinical application of basic laboratory findings as they relate to cause, diagnosis, treatment, and prevention of oral diseases. Clinical studies have yielded data of practical help to the dentist, especially in the areas of high speed instrumentation, dental anesthesia, dental caries, and oral ulcerations. In the latter condition, significant advances have been made in the identification of an L-form of streptococcus in cases of aphthous stomatitis.

The Dental Institute is responsible for dental care services for Clinical Center patients of all of the Institutes.

The research grants program of the Institute contributes significantly to knowledge of underlying factors in oral health and disease. Research activities in the Nation's dental schools, and in many hospitals, local health departments, and other institutions, receive financial support from the Public Health Service.

To help meet the critical need for qualified researchers, the Institute supports training for research in wide-ranging fields. Through graduate training programs in dental schools and universities, students develop skills in clinical and basic research related to dentistry. Some train for the Ph.D. degree, some for combined Ph.D. and D.D.S. degrees. About half of all new training grants are directed toward the basic, nonclinical sciences of great importance to dental research. Coupled with fellowship awards and individual research project grants, such training programs represent a decisive forward step in the development of dental research.

National Institute of General Medical Sciences

THE NATIONAL INSTITUTE OF GENERAL MEDICAL SCIENCES is the only one of the National Institutes of Health whose principal mission is to support research in the basic medical sciences. The Institute also supports research in certain clinical sciences, in areas of interest to two or more Institutes, and in areas not supported by other Institutes or Divisions. The research effort is directed toward understanding the phenomena of living organisms and the causes of disease. Research information obtained through these programs therefore contributes directly to studies in those Institutes which are primarily disease-oriented.

Authorized by Congress in October 1962, the National Institute of General Medical Sciences is successor to the Division of the same name established 4 years earlier.

The Institute's work is accomplished by stimulating, supporting, and coordinating research and research training in universities, medical schools, and similar institutions throughout the United States, and to a small extent in other countries. Support takes the form of grants-in-aid to universities and medical schools for research projects and research training programs, and also fellowships for individuals selected on the basis of research potential.

Among the major areas supported by this Institute are the biochemical sciences. Here, it seems probable that solutions to many problems at the molecular level may be reached. The fundamental nature of such research is reflected in projects concerned with the mechanism of enzyme action, the chemistry and physical properties of proteins and nucleic acids, and the regulation of cellular metabolism.

Controlled mixtures of carbon dioxide, nitrogen, and oxygen are measured in an anesthesia study in the Department of Anesthesiology of the University of Pennsylvania.

Another field which represents a major commitment by the Institute is genetics. At present, the two primary approaches to genetics are: the cellular basis of inheritance, and the behavior and adaptability of whole populations. Such studies have important implications for the future of man on earth—his food, his health, and his mental well-being.

The biophysical sciences program supports projects in which the principles, techniques, and knowledge of the fields of physics, chemistry, mathematics, and engineering are applied to biomedical problems. This research is focused on studies of biological function, organization, and structure. Examples of this research are construction of mathematical models of biological phenomena, pattern recognition studies (one application of which resulted in the development of a rapid mass prescreening technique for uterine cancer), and computer programing systems to speed determination of the structure of complex, biologically active molecules.

The steadily increasing application of mathematics and engineering to modern biomedicine increases the need for broader formal graduate and undergraduate studies as well as for research progams in both of these fields. Focus of this effort is the newly emerging discipline of biomedical engineering, which is receiving strong support from the Institute.

The general clinical sciences are also being emphasized in anesthesiology, diagnostic radiology, and surgery. The Institute's new program in this field is designed to give candidates training in depth in the basic sciences as well as in clinical research.

Because man is constantly exposed to a host of drugs both new and established, it is imperative to understand their actual and potential effects. To this end, the Institute has increased its support of pharmacologically-oriented research projects. It also has launched a major program for the support of university-based pharmacology-toxicology centers for research and training, for improved dissemination of drug information, and for the support of certain types of applied research on a contract basis.

In order to maintain the present momentum of biomedical research, it is vitally important to provide the skilled manpower which alone can assure high quality research in the years ahead. To help meet these needs, the Institute operates training and fellowship programs which enable graduate schools and medical schools to strengthen and improve their research training capabilities.

Support is provided for the training staff and for facilities and supplies. The established disciplines are encouraged and interdisciplinary and even interschool perspectives of the biomedical sciences are emphasized. These training programs are designed to attract and develop graduate students with a high potential for creative, independent investigation and to provide them with opportunities to produce the best work of which they are capable.

Likewise, through its research fellowship program the Institute supports intensive training of young scientists with demonstrated potentials for research careers.

All grants and awards made by this Institute are carefully evaluated for scientific merit by impartial groups of leading nongovernmental scientists and informed citizens who are experts in their respective fields. It is through the combined efforts of these groups and of the Institute staff that large-scale support of biomedical research has been achieved and the Nation's health advanced.

A postdoctoral fellow in chemistry at the University of California, Berkeley, adjusts a flow dichlorism apparatus used in studies of photosynthesis.

National Institute of Mental Health

THE NATIONAL INSTITUTE OF MENTAL HEALTH administers the Federal Government's program to promote sound mental health and to prevent, treat, and cure mental illness which occurs more frequently, affects more people, requires more prolonged treatment, causes more suffering by the families of the afflicted, wastes more human resources, and constitutes more financial drain upon both the public treasury and the personal finances of the individual families than any other single condition.

Established in 1949, the NIMH is engaged in a three-fold program to: (1) support research on the causes, treatment, and prevention of mental illness; (2) support training for the mental health professions; and (3) administer a community services program.

Under a new national mental health program administered by the Institute, Federal funds will help build and staff a network of community mental health centers, offering comprehensive psychiatric services throughout the country.

An NIMH scientist observing changes in behavior patterns of a monkey that has suffered brain damage.

Individual psychotherapy, sometimes called "the talking cure," is a common means of treating emotional problems.

The program shifts the focus from isolated State mental hospitals to care provided by the community within the community. The Federal Government provides "seed" money to the States and communities to aid in the financing.

These centers are to serve as the nucleus of a broad program that promises to improve mental health care and prevent the occurrence of mental illness.

Although a center is not necessarily a new or separate building, it is the center of a constellation of mental health services in the community, in one or more settings, under a unified system of care.

Each center will provide as "essential services," inpatient treatment, outpatient treatment, partial hospitalization, emergency services, consultation and education.

The key to the entire national program lies in the training of adequate numbers of both professionals and nonprofessionals to man the centers, as well as to conduct research. NIMH supports the training of thousands of men and women in graduate schools across the country, preparing them especially for work in the "core" mental health professions—psychiatry, psychology, psychiatric social work, and psychiatric nursing. The Institute also fosters the use of nonprofessionals in mental health services, to free professionals to do the work that they have been trained for.

Special grants are available to help upgrade the level of care in State mental hospitals. These Hospital Improvement Project Grants along with Inservice Training Grants, are intended to provide for immediate improvements through specific projects undertaken by the hospital.

In addition to its training and community mental health centers activities, the NIMH is the largest source of support for mental health research in the world. Institute-supported scientists conduct research in some 350 universities, medical centers, hospitals and other institutions throughout the United States.

The Institute also supports research demonstration and other projects to strengthen mental health services in the States.

Mental Health research into many aspects of the human mind and behavior, stresses interdisciplinary activity, and the Institute encourages cooperation among psychiatry, psychology, sociology and biology, and other sciences.

Investigators look into the psychological and emotional causes of organic illness, as well as the physical determinants of mental illness. They probe the effects of the environment and heredity on mental disorders, delinquency, drug addiction, alcoholism, suicide. They seek solutions to the problems of interpersonal relations, industrial mental health, urban crowding, as well as seeking chemical and genetic clues to specific mental illnesses.

Through its comprehensive program of research, training and community services, the Institute hopes eventually to eliminate the scourge of mental illness by bringing new knowledge of the mental illnesses, and mental health services to all those in need of them.

Art therapist works with patient while psychiatrist records conversation and observes efforts of her brother and parents in family art therapy session.

National Institute of Neurological Diseases and Blindness

THE MARVEL and the mystery of the brain and central nervous system in health and disease stimulate research at the National Institute of Neurological Diseases and Blindness (NINDB). The brain controls all physical and mental action. While it makes up only 2 percent of the body weight, the brain requires one-sixth of the heart output and consumes nearly one-fifth of the oxygen used by the body.

Lack of oxygen for the brain cells is a well-known cause of rapid and permanent brain damage. Yet further discoveries continue on the causes and results of oxygen lack. In an Institute monkey colony in Puerto Rico, when oxygen is withheld at birth, baby monkeys show symptoms resembling cerebral palsy.

Every discovery about the brain offers a possible clue toward conquest of the 200-odd neurological ailments in which the Institute faces research problems. Improvements of the technique of artificial low body temperature called hypothermia make neurosurgery of the brain safer, and improve the medical care of brain injury and an increasing number of ailments.

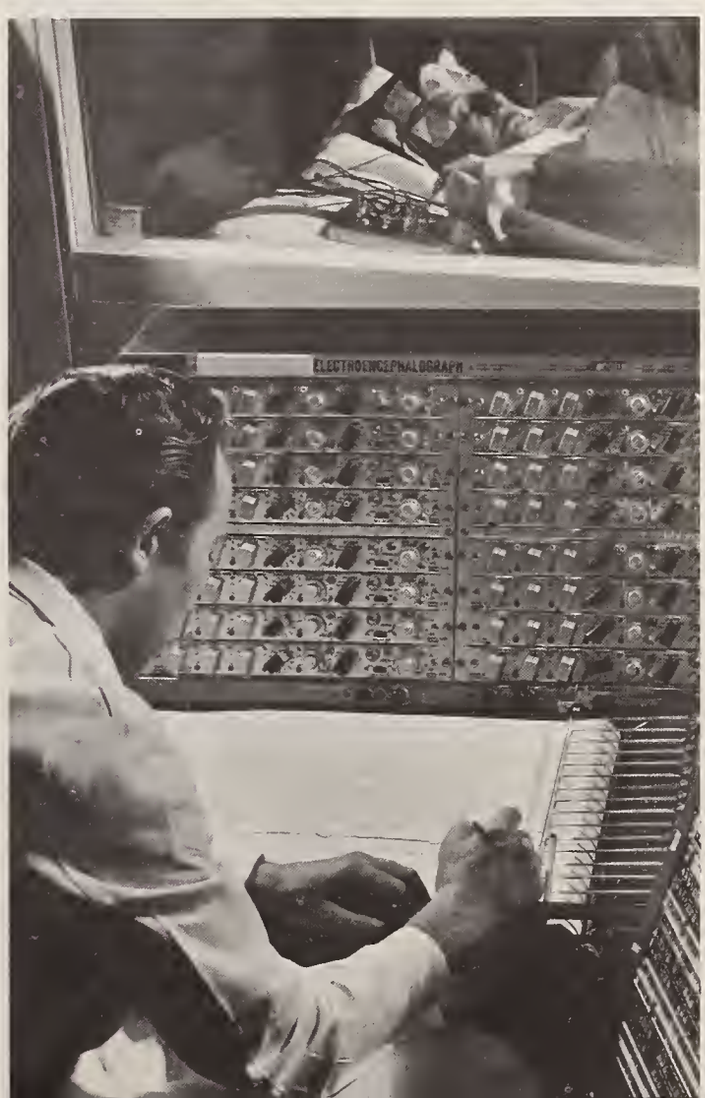
An unprecedented attempt to find the causes of cerebral palsy, mental retardation, congenital blindness, and kindred defects in children was launched by the Institute in 1959. About 60,000 women throughout the country are being studied from early pregnancy through delivery. Their infants are being observed intensively in their critical early hours, and will be followed regularly until at least 7 years of age.

Fourteen hospitals and medical centers are collaborating with the Institute on this pioneering program. Obstetricians, pediatricians, and many other specialists are working together to make painstaking observations.

This is the first large-scale research project to gather facts on the period of infant development *before* serious ailments appear. Previous studies always had to look back for possible causes *after* cerebral palsy, mental retardation, or other ailments were diagnosed.

From this study, scientists hope not only to learn more about known causes, but also to discover pre-

Research, using the EEG (electroencephalogram), improves diagnosis of epilepsy and other brain ailments.



viously overlooked causes of neurological ailments.

Already, NINDB scientists have found that toxoplasmosis and salivary gland infections are much more common during pregnancy than had been suspected. They might rank with German measles in early pregnancy as a cause of blindness, deafness, and mental retardation in the baby.

NINDB virologists have developed a simple and rapid blood test for diagnosing German measles. This reduces the identification time from about 2 weeks to about 24 hours.

Other ages than early childhood also have their clusters of neurological diseases. Some, such as epilepsy and encephalitis, afflict persons at any age. Muscular dystrophy (MD) may be a problem in later childhood. A test for one type of carrier of MD enables families to avoid this hereditary form.

Adults in the productive years may become helpless from multiple sclerosis, myasthenia gravis, or amyotrophic lateral sclerosis. In the later years, the major afflictions are blindness, deafness, stroke, brain tumors, and Parkinson's disease. Institute scientists search for causes, occurrences, ways of improved diagnosis and treatment, and always, of course, prevention.

Neurological ailments add up to the leading cause of permanent disability and the third cause of death in the United States.

The Institute has several studies involving the evaluation of drugs for epilepsy, headache, multiple sclerosis, and other neurological diseases.

Along with the study of eye disorders such as glaucoma, cataracts, and uveitis, Institute ophthalmologists are making electron microscopy studies of the eye covering, lens, and optic nerve.

Research is supported on causes of the overgrowth of bone in the middle ear which prevents the tiny stapes from vibrating to conduct sound waves. Improved surgical techniques supported by NINDB grants aid in restoring hearing.

Biochemistry offers a great hope for prevention and treatment of several neurological ailments. Both histochemistry and cytochemistry are improving the sharpness of diagnosis of the various neuromuscular diseases, and adding hope for discovery of treatments.

A refinement of brain X-ray technique, called axial transverse encephalography, has been developed by NINDB scientists. With it, certain brain tumors and other abnormalities which previously escaped attention can be located.

At an NINDB-supported conference, scientists learned of a "subtraction technique" by which bones of the skull are cancelled out in X-ray pictures. This leaves a clearer view of the blood vessels and helps the diagnosis of such neurological ailments as stroke.

Research in the new field of human cytogenetics (microscopic studies of cells and their chromosomes) has started at the Institute.

Epidemiology is increasingly used to study the occurrence of neurological diseases. In multiple sclerosis, for example, in the United States and other countries, many more cases have been found in colder than in warmer climates.

Research grants support both basic and applied research projects comparable to those carried on inside the Institute. One large cooperative study on prevention of cerebrovascular diseases investigated anticoagulant medicines to discourage repeated brain damage from blood clots. Another study sought best ways of controlling the swollen, weakened blood aneurysms which threaten the brain.

In recent years, the number of investigators prepared for neurological research has been increasing with the aid of Institute training grants. This has quickened the tempo of research and is multiplying the possibilities of helpful discoveries.

In the national NINDB-supported Collaborative Perinatal Research Study which involves 50,000 infants, the alertness of each child is tested regularly.

Clinical Center

THE CLINICAL CENTER symbolizes the remarkable increase of public interest in medical research during the past 25 years. Congress in 1947 authorized establishment of the Center to provide clinical study facilities and additional laboratory space at NIH. Construction was begun the following year, and the first patients were admitted on July 6, 1953. The full capacity of the Center is 516 patients and approximately 1,100 laboratory units.

Antedating all scientific specialties, and more important now than ever before, is the study of health and disease in individuals. This is the science of clinical medicine as practiced since ancient times by physicians in homes and hospitals. To a great extent, medical knowledge has grown by just this process. In observing sick humans and attempting to restore their health, physicians are constantly acquiring new evidence concerning the causes of illness, and developing better methods of diagnosis, prevention, and treatment. Today this process of observation and discovery is accelerated by special research facilities such as the Clinical Center.

If medical knowledge is to continue to advance, sharp lines cannot remain between various health problems and scientific approaches. Here is where clinical medicine, which concentrates on the whole man, serves its greatest research mission. The Clinical Center was planned so that representatives of all the medical sciences could work together closely with clinicians, contributing not only to one another's research but also to the more effective treatment of patients. The Center is equipped so that every research tool needed by these workers is available.

The division of space in the Clinical Center reveals its coordinating function. Each Institute has patient bedrooms and research laboratories in close proximity. The facilities for diagnosis, medical and nursing care, social service, rehabilitation, and recreation are comparable to those found in any good modern hospital.

The laboratories are so designed that they can be readily modified to meet the changing requirements of research with a minimum of delay and expense.

That the Clinical Center is more than a hospital is illustrated by its carefully selected patient population, which includes both sick people and normal volunteers.

Patients are selected solely because they have a condition needed in a particular study by one of the Institutes sharing the Center. They must be referred by individual physicians or other qualified medical sources, and they are accepted from any part of the country. Hospitals, clinics, family physicians, and specialists in various diseases not only refer their patients, but through consultation, followup treatment, and observation, actively participate in the research.

Normal volunteers are carefully selected on a medical basis, also, and they must be referred by a reputable community agency willing to sponsor them. These healthy "patients" play an important part in helping scientists gain knowledge of what is normal and healthy, which is often a prerequisite to a more thorough understanding of the ills that befall mankind.

Many studies depend upon the patients' remaining in the Center for long periods—often 3 or 4 months. The approximate length of stay is explained to patients at the time of admission. It is also explained that they will be discharged back to the care of their

own physician when their participation in a study has been completed and when their condition permits. After discharge, followup examinations or treatment may be given periodically for a few months to 10 years or more—a most important procedure in medical investigations. Special facilities for the comfort and morale of patients encourage them to stay for the entire time they are needed and to return to the Center upon request. Patients do not pay for the nursing and medical care received while they are participating in a research project. However, transportation costs are not borne by the Center.

As in every good hospital, the medical and surgical care received here is based on the ruling concept that the welfare of the patient has priority over all other considerations.

The methods of treatment employed are substantially the same as those accepted and used by well-qualified physicians everywhere. Far more extensive and frequent, however, are the laboratory tests and other examinations made for research purposes. All clinical studies are reinforced by fundamental laboratory investigations. Conversely, many laboratory investigations are stimulated and enhanced through the close relations maintained with clinical medicine.

Much of the above is summarized in six basic principles that have guided NIH in its clinical research program:

- The individual selection of Clinical Center patients is based solely on the part each can play in a specific study.
- Patients selected as research subjects are given medical care of the highest quality.
- The design and operation of the Center foster interchange of ideas and skills among all the major biological and medical specialties—basic laboratory, preclinical, and clinical.
- Resources of the Center are available for collaborative research by established scientists from other institutions, and opportunity is provided for able young clinicians to gain specialized training for independent careers in research medicine.
- In assembling the staff, every effort is made to minimize the impact on local medical and educational institutions.
- In obtaining patients for study, close collaboration is maintained with physicians, hospitals, medical schools, and clinics—the purpose being not to interfere or compete, but rather to permit medical practice, teaching, and research to proceed together in harmony.

Circular operating room contains physiological monitoring and other electronic equipment to aid surgical team.

Division of Research Grants

THE DIVISION OF RESEARCH GRANTS was established in January 1946 to administer a group of nine grants for research in cancer and a small group of research projects that had been transferred to the Public Health Service at the end of World War II by the Office of Scientific Research and Development, a war-emergency agency. It was also charged with responsibility for stimulating research in the biomedical sciences and developing and administering the grant-in-aid program authorized under section 301 of the Public Health Service Act of 1944.

Successful completion of the transferred projects, following the spectacular results attained by grant-supported medical and other research for military use during the war, aroused the interest and subsequent support of the Congress. From the support, manifested by annually increased appropriations, has evolved a PHS grant program that now functions on both national and international levels.

Initially known as the Research Grants Office, the new unit rapidly achieved Division status and acquired responsibility for initial review and evaluation of all NIH research grant and fellowship award applications. As the programs developed and the number of applications increased, the Division's organization was accordingly adjusted so that it eventually became the focal point for coordination of all PHS extramural grants-in-aid programs.

The principal function of DRG is to provide scientific review and evaluation of grant and award applications through the mechanism of study sections and review committees, and to recommend to the national advisory councils those most worthy of support.

All applications are received in the Division of Research Grants where they are acknowledged, processed, and referred to the appropriate study section or review committee and to the Institute or Division that will accept responsibility for support of the project if it is approved. There are now about 60 study sections and committees, each composed of accomplished scientists, educators, and other outstanding people representing the fundamental sciences, medicine, education and public affairs. These groups meet three times a year. Each proposal is considered on its scientific merit, the ability of the investigator, the adequacy of available facilities, the relationship of budgetary estimates to the proposed work, and the overall significance of the project in relation to the need for knowledge in the scientific areas involved.

The findings of the study sections are then submitted to the appropriate national advisory council through the supporting Institute or Division for final review. The councils assess the worth of the proposals from the standpoint of policy, program needs, and availability of funds, in addition to review for scientific merit.

Similar procedures are followed in the review of applications for fellowship awards. Applications are reviewed by the Division's Central Qualifications Board, made up of 13 fellowship review panels which are also organized by scientific disciplines. These panels consist mostly of non-Federal university scientists, and they, like the Study Sections, confine themselves to technical, preliminary review. Their recommendations are transmitted to Specialty Fellowship Boards in the Institutes into whose fields the candidates' interests

fall. The Fellowship Review Panels also report on training needs in their fields.

Applications for training grants are processed in the Division and then referred to the appropriate Institute or Division for review by training committees.

The national advisory councils and committees are responsible to the Surgeon General for final recommendation on approved applications. No award may be made that has not had the approval of an advisory council or committee.

Another function of the Division is to coordinate the formulation of policies and procedures governing the programs, and to direct the review, codification, and dissemination of policies and procedures relating to the management of grant funds by the grantee institutions. Thus the Division is a central contact point for administrative officials in over 2,000 grantee institutions. It also maintains records regarding awards as well as records of expenditures by the grantees.

The Division also compiles data on the more than 28,000 active grants and awards that comprise the extramural program. Data are collected from applications and other sources and coded on magnetic tape for NIH's electronic computer. The Division produces compilations, analyses, and special groupings of data to accommodate the many requirements of program management staff. A number of statistical reports, both periodic and special, are published annually.

In addition to providing operating statistics and continuing review and analysis of research and training supported by PHS funds, the Division prepares and disseminates information on the extramural grant and award programs to the press and the scientific community; and stimulates through seminars, symposia, and other means, the initiation and expansion of research and training in the health and health-related sciences.

The Division undertakes broad-scale staff studies and review of various aspects of the extramural program for the information of NIH management and other public officials with an interest in health and medical affairs. The scientific evaluation of programs is another service provided by the Division for administrative use.

The Division collects information on the scientific content of projects conducted under PHS research grants and intramural programs. This contribution is particularly useful to administrators and advisors concerned with maintaining balance in the program, and to scientists needing information about the work of colleagues. To help meet the latter need, an index is published each year of the scientific content of all current PHS-supported research projects. The index provides a quick cross reference to all work being done by PHS grantees on any subject falling within the spectrum of medical and biological research.

Advisory study sections and committees give initial scientific review to applications for research support. Here the Virology and Rickettsiology Study Section, composed of non-Federal experts, discusses the merits of a project.

Division of Biologics Standards

THE DIVISION'S primary function is to administer those provisions of the Public Health Service Act pertaining to the safety, purity, and potency of biological products, often referred to as biologics. Many of these products are derived principally from pathogenic microorganisms, and their preparation requires careful control.

Experience has shown that such control can be accomplished most effectively within the context of an active research program. Thus, the programs of the Division are product-oriented; their scope, direction, and intensity are dictated by the need to provide essential information for the development of requirements and regulations for new products, as well as for the continuous improvement of tests to ensure the safety, purity, and potency of existing products.

Control measures are based on a system of licensure. Following determination by the Division that the prescribed standards for safety, purity, and potency have been met, licenses for the manufacturing establishment and for the product are issued by the Department of Health, Education, and Welfare upon recommendation of the Surgeon General. As of November 1, 1965, 214 establishment licenses and 1,310 product licenses were in effect, the latter covering 294 specific products.

The standards prescribed by the Division for the production and testing of biological products are set forth in regulations which are continually reviewed for adequacy. As scientific knowledge advances, revisions may be made. Once a product is licensed, continuing surveillance is maintained by periodic inspection of the manufacturers' facilities and production methods, review of records of production and testing, and by the testing of representative samples of products in the Division's laboratories.

Since most biological products cannot be standardized by chemical or physical means, their potency must be tested in relation to established reference preparations. To establish uniformity of potency, the Division provides standard or reference preparations to establishments engaged in biologics standardization. The development of these standards depends on intimate knowledge of advances in immunology, biology, virology, biochemistry, and medicine. Of major consideration are improvement of methods of preservation and storage, such as freezing and drying, so that potency is maintained; selection or development of preparations which yield clear-cut endpoints in the control testing performed by manufacturers; and correlation, where possible, with standards established in other countries or with international standards. Approximately 6,000 standard or reference preparations are distributed each year by the Division to commercial establishments, health departments, universities, and research organizations.

Research to provide basic data on the properties of reference preparations and to maintain their continuing stability is being carried out.

The research programs of the DBS laboratories—Control Activties, Bacterial Products, Biophysics and Biochemistry, Blood and Blood Products, Pathology, Viral Immunology, and Virology and Rickettsiology—include a wide range of projects, many of immediate practical urgency and all having direct relation to control of biologics. These programs include research on: the physical and chemical factors that determine the

Large quantities of organisms are grown in room-size incubators, and the growth medium will later be fractionated in attempts to develop more specific reagents for tuberculin skin tests.

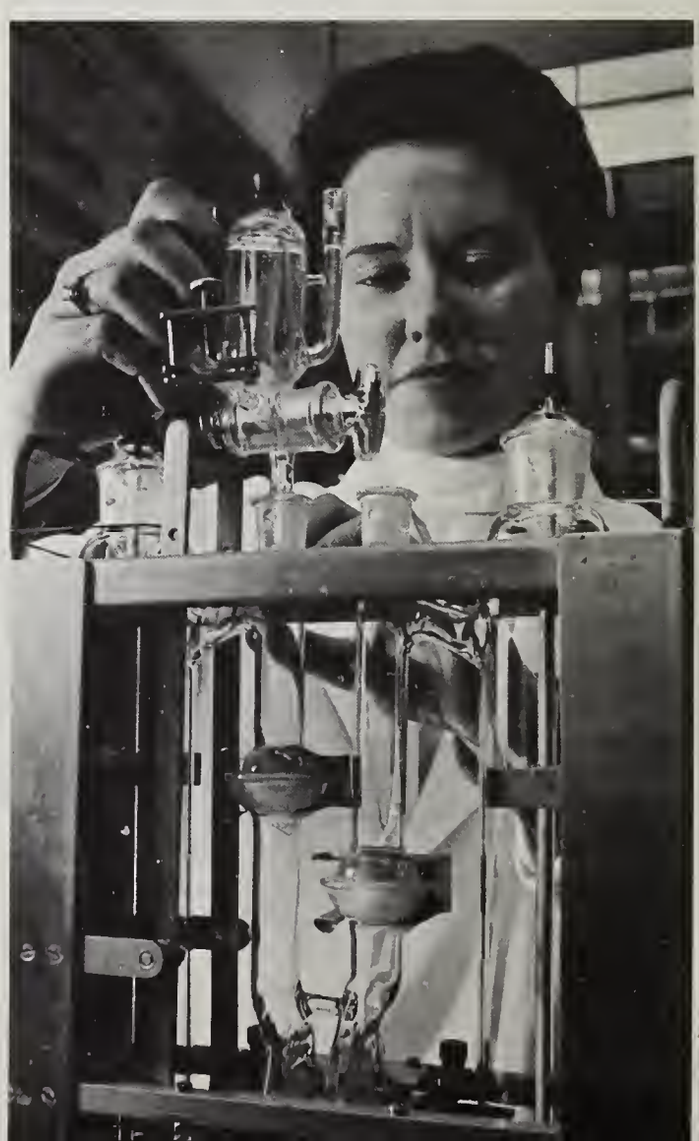
biological properties of viruses, bacteria, and rickettsia, as well as their host cells; the pathogenesis of infectious diseases as it relates to biological products now in use and those in the developmental stage; the development of animal, serological, and tissue culture tests for viral products such as influenza, measles, and poliomyelitis vaccines; bacterial infections and test procedures for bacterial products such as cholera, pertussis, typhoid, and BCG vaccines, and diphtheria and tetanus toxoids; the rickettsial infections, such as epidemic typhus and Rocky Mountain spotted fever, for which vaccines are routinely used in certain areas; allergenic products used for diagnosis or treatment of allergies such as ragweed, house dust, and poison ivy; and the preparation, preservation, and safety of whole blood and blood products, as well as diagnostic reagents for grouping and typing blood.

The older, established products such as yellow fever, smallpox, and typhus vaccines, as always, demand attention. Smallpox, for example, continues to be an important health problem in much of the world. It will be a threat to smallpox-free countries like the United States until it is eradicated from endemic areas. This requires that the Division maintain a continuing program of research and control to ensure potent and stable vaccines.

The Federal Government's responsibility for the control of biological products began on July 1, 1902, when the Congress passed an act to regulate the sale in interstate commerce of all viruses, serums, toxins, and analogous products applicable to the prevention and cure of diseases of man. The statute, now a part of the Public Health Service Act, is basically the same as in 1902. At that time the technical responsibilities of the biologics program were assigned to the National Institutes of Health, then known as the Hygienic Laboratory. In 1937, the Laboratory of Biologics Control was created within the then National Institute of Health, and in 1948 was made part of the National Microbiological Institute.

In June 1955, authority was granted the Surgeon General by the Secretary of Health, Education, and Welfare to expand the biologics control function of the Public Health Service to the status of a separate division within the National Institutes of Health—the Division of Biologics Standards.

The protein composition of certain licensed blood derivatives is determined by using moving boundary electrophoresis, one of the many control tests conducted in DBS laboratories.



Division of Research Services

THE DIVISION OF RESEARCH SERVICES provides facilities, equipment, and a wide variety of scientific and technical services essential to the needs of the medical investigators and research administrators at NIH.

It is one of several NIH Divisions created to supplement the categorical research programs of the Institutes. The research contributions of its personnel are often the result of close collaboration with Institute scientists.

Through the design of precision instrumentation, for example, the achievements of biomedical engineers and skilled technicians employed in the Division are directly linked to major research efforts at NIH. Instrument makers have contributed to mental health and neurology research by developing an apparatus that first generates electrical pulse trains to stimulate cortical areas in the brain, then displays and photographs the resultant cell discharges on an oscilloscope. They have developed an automated instrumentation system whereby sequential functions in clinical pathology can be televised and photographed at precise time-intervals.

The Division provides the NIH research investigator with (1) a growing collection of scientific literature and translations by means of which he keeps abreast of new developments in his own field and in all other research areas, (2) charts, photomicrographs, exhibits, clinical illustrations, slides, and motion picture services for visual documentation of his research findings, (3) conventional and inbred animals for experimental work in the laboratory, and (4) planning and consultation on laboratory design, instrumentation, and healthful environmental conditions.

In addition, it operates the physical plant at Bethesda and the NIH Animal Center, a 500-acre animal farm for holding and treating laboratory research animals. The Center includes a farm animal building, a dog and cat kennel with an attached animal hospital facility, and a powerplant.

In years past the Division's sanitary engineers pioneered efforts to produce germfree animals at NIH, to sterilize animal food and equiment, and to design lightweight, portable chambers for the transport and delivery of these animals. They have continued this activity by undertaking the conversion of NIH facili-

A photographer catches the technique on film as an investigator sterilizes heat-sensitive food items at the entrance of a germfree tank. Since the spray is toxic, both men wear protective masks.

ties for the large-scale production of germfree and specific-pathogen-free animals. Sanitary engineers have also contributed to the high standard of laboratory sanitation at NIH by conducting occupational health studies and bacteriological studies of the environment.

For scientists to conduct the most productive research, good equipment and a suitable place to work is essential. In a situation as complex as that which exists at NIH, there is need for a group of specialists whose only function is to insure that a satisfactory physical environment is being maintained. Mechanical, electrical, civil, architectural, and construction engineers closely coordinate the design and construction of buildings with the scientific staff to insure the most up-to-date laboratories and physical facilities. In other instances the engineers work closely with laboratory scientists in the research and development of specific problem areas, such as fume hood studies.

Other DRS employees are skilled in a wide range of crafts and technical and professional specialties. Included on the personnel roster are biologists, entomologists, geneticists, librarians, medical artists, photographers, scientific translators, veterinary scientists, animal husbandmen, carpenters, electricians, glassblowers, horticulturists, plumbers, tree surgeons, varitypists, and welders.

This array of skills has been assembled to give NIH scientists the necessary tools with which to pursue their research interests under the best possible working conditions.

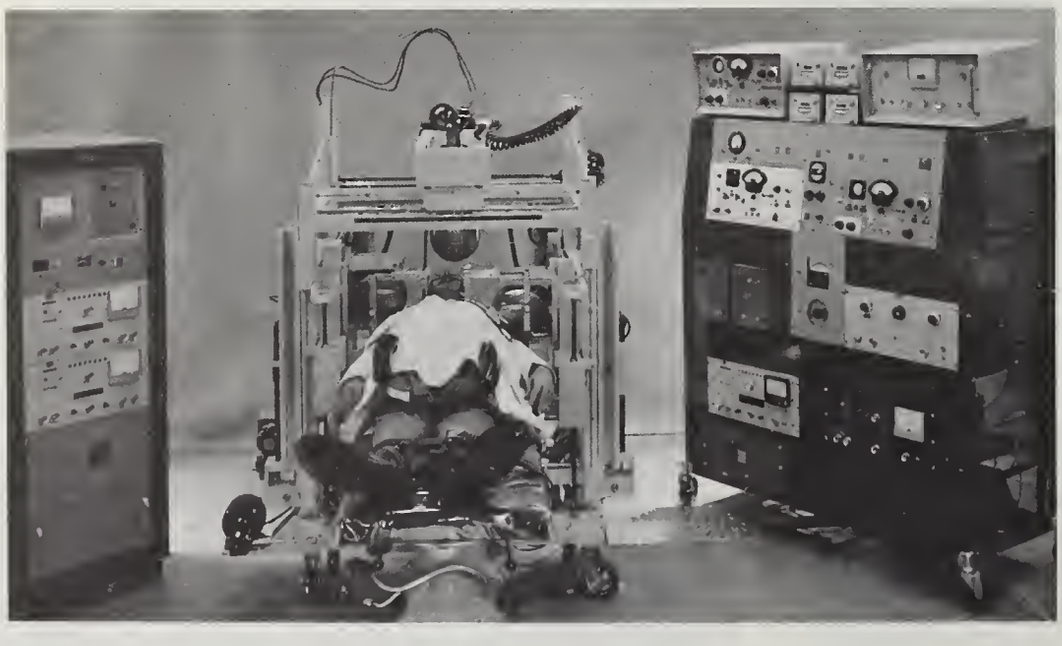
The scientists replenish their supplies of laboratory glassware and bacteriological culture media from the Division's central service. They order conventional inbred, and exotic species of laboratory animals from its animal colony, and rely on the animal hospital and on the advice of DRS veterinarians for the treatment of animal diseases. Thousands of small laboratory animals are bred each year for the study of the ills that afflict mankind, and other animals are obtained through commercial, domestic, and international sources.

Plastics research conducted by the Division's medical artists has yielded numerous benefits to NIH in the form of plastic heart valves, museum mounts, psychological testing materials and embedded pathological specimens. Lightweight scientific exhibits are achieved with plastic panels in a variety of contemporary design combinations.

Clinical illustrators and photographers also contribute to the visual documentation of research, and science librarians and translators help the research investigator communicate his findings to the scientific world.

NIH has one of the world's leading medical libraries, geared to assist scientists in tracking down obscure clues to research problems. The Library gives investigators access to the research reports that shape the course of their projects and outline their methodology.

Of the thousands of visitors who come to NIH each year from all parts of the globe, many come to learn in depth about the central research services provided for our research investigators.



Designed and constructed at NIH, the Tetrascanner simultaneously scans four aspects of the head of a simulated patient to detect tumorous tissue of the brain.

Division of Research Facilities and Resources

SUPPORTING the individual scientist in pursuit of his own research goals is no longer enough. No scientist, regardless of ability and training, can conduct productive research without modern tools and a suitable place to work. Provision must be made for laboratories and other facilities, for complex equipment, and for unforeseen contingencies.

To meet many of these critical and often costly needs, not easily justified on a categorical or a simple project-oriented basis, NIH over the years established diverse programs within its Institutes and Divisions. These programs, though dispersed, had in common the support of extramural facilities and resources involving many disease categories and many scientific disciplines.

In 1962, the NIH consolidated these programs into one administrative unit comprised of five branches. This unit, the Division of Research Facilities and Resources, now serves as a focal point for the administration and management of NIH programs intended to provide the scientific community with the large institutional resources necessary for the conduct of sophisticated biomedical research and indispensable to the achievement of medical advances.

The five branches of this Division and their functions are:

Animal Resources

As the number of biomedical research studies has increased so has the need for more laboratory animals, the usual as well as the unusual species and special strains. Along with the more extensive use of animals in research has developed the field of laboratory animal medicine concerned with the care and proper maintenance of the animals. The Animal Resources Branch, in response to growing national research needs supports laboratory animal facilities and resources, encourages high standards of care for research animals, and supports studies to investigate disease problems of laboratory animals. This program also helps to fund postdoctoral training of professional personnel in laboratory animal medicine.

In the seven regional primate research centers supported by this program, visiting scientists representing many disciplines use primates in biomedical research. These centers are models for the care, housing, and humane use of laboratory animals.

General Clinical Research Centers

The program of the General Clinical Research Centers Branch supports centers where scientists conduct studies on a wide range of human diseases using the full spectrum of the biomedical sciences. Costs underwritten by the grants include those for renovation, for operational expenses such as staff salaries, equipment and supplies, and for hospitalization.

A discrete unit in a hospital, the general clinical research center is a research ward containing a small number of research beds separate from the general care wards. Each center has its own professional and technical staff and its own specialized laboratory facilities. The broad scope of research on many diseases conducted in these centers and the fact that scientists from many departments of an institution use a center, distinguishes them from categorical centers.

With scientists from different disciplines working together, opportunities abound for research on any clinical problem and for the stimulation of research

ideas. In addition, the centers are a model of excellence for clinical research and research training within the institution.

General Research Support

Grants administered by the General Research Support Branch provide funds for direct costs of health research and research training to schools of medicine, dentistry, osteopathy, public health, veterinary medicine, pharmacy, and nursing, and to hospitals and other nonprofit institutions that conduct research.

The unique feature of this grant program is that it permits more latitude in the immediate use of funds than is possible with other types of Public Health Service grants. While granting funds for certain specific purposes, this program also provides for unforeseen expenses which occasionally arise and for which there is no other provision, such as for a small computer or an animal colony for general research purposes.

General support funds are also used to finance the investigation of ideas which, though promising, are not ready for critical scrutiny by a research grant study section. These grants may be used for salary support enabling scientists and other staff members to continue their work during interim periods of other grant support.

In many instances, a general research support grant appears to have a multiple impact on the institution's research and research training activity as a whole.

Health Research Facilities

Before the rapid acceleration of biomedical research in the last decade, many institutions had poorly equipped laboratories often in old and obsolete buildings with totally inadequate space. Medical and other health related institutions need additional research space and equipment for the continuing expansion of research and research training activities. Institutions have learned that the quality and adequacy of research facilities are often the determining factors in the competition for high-caliber scientists.

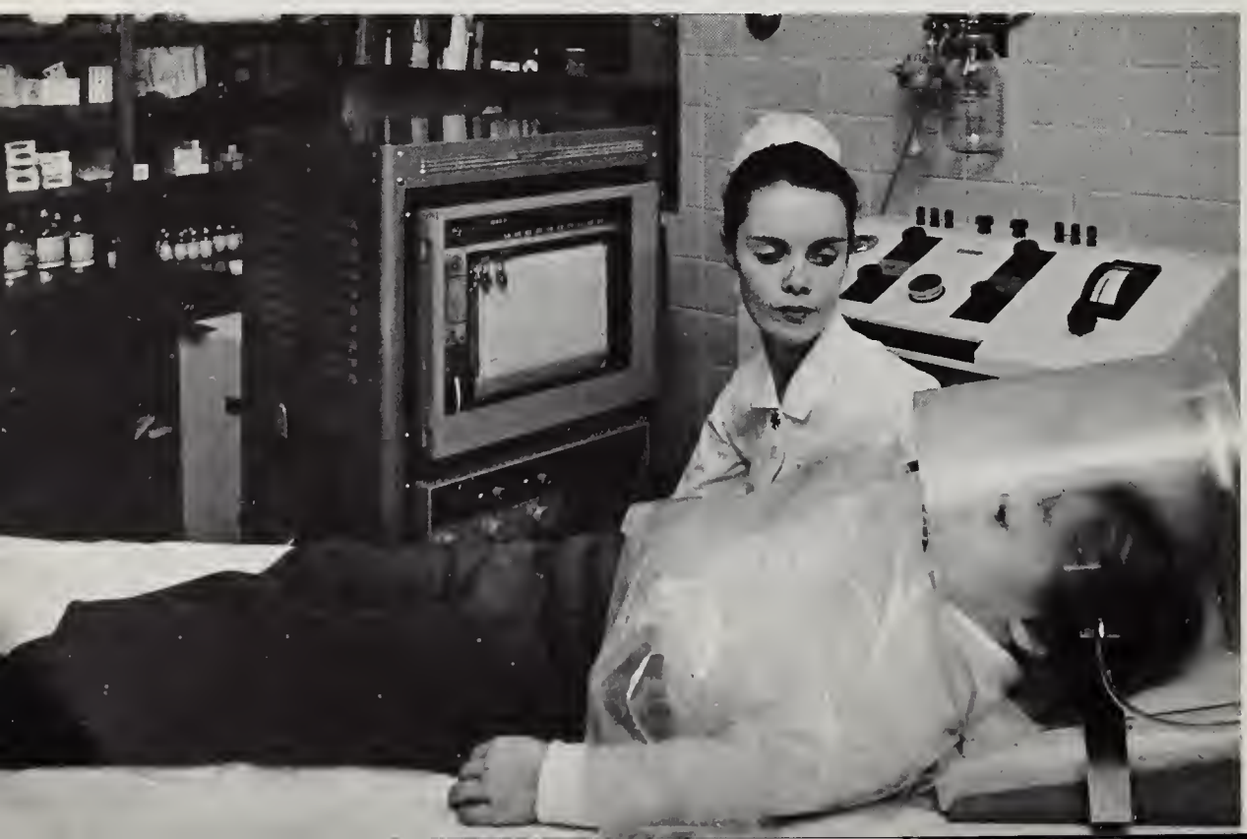
In some instances, it is possible to expand facilities by remodeling and renovation, but more and more situations indicate that the best and most economical solution is to construct new buildings specifically designed to meet modern research needs.

The Health Research Facilities Branch supports the construction and equipment of facilities for health research, research training, and related purposes. Awards are made on a matching basis for up to 50 percent of the construction costs. The program encourages institutions to build needed facilities and to seek funds from non-Federal sources to match those awarded by the Public Health Service. This Branch also provides up to 75 percent of the construction costs for mental retardation research centers.

Special Research Resources

Centers supported by the Special Research Resources Branch provide unusual and highly specialized research services to many institutional departments and disciplines to meet the needs of biomedical investigators in a variety of disciplines. Computer centers, biomedical engineering centers, and scientific and technical information facilities are among the types of special resources provided by these grants.

Because only maximum use can justify the cost of such expensive equipment they are established as centralized facilities available to a wide community of biomedical investigators.



Nurse observes youngster under "space hood" while a "diaferometer" measures oxygen intake and carbon dioxide output in study to compare these factors in normal and cardiac children. The study is being conducted in the children's general clinical research center in Johns Hopkins Hospital, Baltimore, Md. The center and core staff are supported by grants administered by the Division of Research Facilities and Resources, NIH.

Division of Computer Research and Technology

OVER THE PAST decade or more, electronic computers have helped make possible greatly accelerated advances in the physical sciences. In some instances—space exploration is perhaps the most dramatic example—they have been, and are, *a sine qua non* for an entire technology.

By contrast, their use in the life sciences has been slow in developing, and even today their potential in biomedical research is only beginning to be tapped. In recognition of this fact, the Division of Computer Research and Technology was established in 1964. Its mission is to conduct an interdisciplinary effort directed toward the exploitation by the life sciences of the concepts and methodology of mathematics and computer technology.

The Division's staff encompasses the range of professional and technical talents needed to make a biological problem amenable to digital computer processing and solution. These include systems analysts who chart the total problem in a logical form; mathematical statisticians who assist in experimental design and analysis; mathematicians who give mathematical expression to physical phenomena; engineers who design and develop laboratory instruments for quantifying biological and other experimental data; programers who translate the problem into the language of the computer; and operators who oversee the computer processing of the problem.

In addition to providing NIH with computational and data processing services through its central computer facility, the Division conducts research in mathematics, mathematical statistics, and computer programing. Although a portion of this research is theoretical, most of it is directed toward specific application in the NIH environment, and takes the form of collaboration with Institute scientists on studies and projects where mathematics and the computer can play a productive, and in some cases indispensable, role.

The fruits of this collaboration may be many and varied: development of mathematical models of biological systems which permit novel approaches to medical research and offer potential diagnostic tools; enhancement of the capabilities and achievements of the biomedical scientist through the rapid conversion of laboratory data to forms that permit efficient computer processing and analysis; development of retrieval systems that provide wider and more rapid access to and dissemination of scientific information generated by specific research undertakings; use of computers for the interpretation of X-rays and the automatic scanning of laboratory specimens; and the automatic retrieval of laboratory information for such programs as clinical pathology, including rapid correlation of the results of laboratory tests with already existing patient data.

Collaboration between the computer specialist and the medical scientist can be productive only if each has a conceptual understanding of the other's field of specialization. For this reason, the Division attempts to provide a link between them in two complementary ways. First, it seeks to maintain at all times a staff which, while basically computer and mathematics oriented, has representative skills in physics, chemistry, biology, and the behavioral sciences. Second, it carries on a continuing computer training program designed both to assist individual scientists in making effective use of computers in their ongoing research projects and to stimulate among the scientific staff in general a greater understanding of the present and potential uses of computers in biomedical research. In the past 3 years, more than 200 NIH scientists have

availed themselves of this training, and increasing numbers of them have become proficient in preparing their own computer programs.

As more and more NIH scientists become sophisticated in the technology of the computer, and as the technology itself advances, it can be expected to assume a far more significant place in the medical research laboratory setting than at present. It has, of course, already made some important contributions in the laboratory. Scientists of the National Institute of Mental Health, for example, have been able through the use of a small but powerful laboratory computer to trace in detail the spread of an electrical impulse along a nerve fiber and to display the accompanying pattern of electrical signals on a cathode ray tube. The value of this capability is that it provides visual results of an experiment while it is still in progress. Without the tremendous computational speeds offered by the computer, this would not be possible. As another example, NIH scientists engaged in studies on the chemical and molecular structure of biologically important molecules are calling upon the computer to help them determine the most probable among the almost limitless number of possible sequences of amino acids in a protein. A degree of certitude on the sequence is important for further laboratory investigation of molecules.

Despite these and other promising accomplishments, the computer has scarcely begun to make its contribution in the laboratory. A harbinger of the more significant developments to come is the "hybrid" computing system installed in the Clinical Center as a joint venture of the Division and the National Heart Institute. The system, which permits instantaneous conversion of analog data to digital form for mathematical analysis by a digital computer, will greatly enhance the scientist's ability to interpret and utilize the mass of data collected during heart surgery. And beyond the "hybrid" lie exciting possibilities for using the new data generated by computer analysis to construct, evaluate, and challenge mathematical models of physiological functions. In this way, the biomedical scientist will gain new and valuable insights into the basic nature of extremely complex, multivariate physiological systems that have defied analysis by classical experimental approaches which seek to control rigidly all but a single variable. The mathematicians, mathematical statisticians, and electronic engineers of the Division will play an important part in this endeavor.

While participation in the automation of laboratory processes offers perhaps the greatest and most exciting challenge to the staff of the Division, this is only one of several areas in which it makes an important contribution to NIH programs. The impact of the information explosion has been felt as much in medical research as in any of the scientific fields. Much of this information, while potentially of great value to investigators, is rendered virtually useless by the lack of means for retrieving it rapidly and selectively. Systems analysts of the Division engage in a continuous effort to develop and refine methods of data storage and retrieval which will solve this problem.

A similar challenge exists with respect to the massive and varied data collected in the course of epidemiological studies on large population groups. Here the problem is even more complex, since it involves not only systems of data retrieval, but also the development of statistical methods that make it possible to draw meaningful conclusions from the data. Mathematical statisticians of the Division support the Institutes in this area by providing advice and assistance on the kinds and volume of data that must be collected to yield statistically valid results, and by providing guidance in the analysis of the data.

The Division also provides the NIH grants management and internal administrative and central service operations with advice and consultation on automation. In the case of the grants program, the ultimate goal is an integrated system that provides rapid access to many items of data on each of the thousands of grants administered by NIH.

The flow chart, being explained here to the biomedical researcher, is used to represent graphically the detailed logical steps of the data processing cycle. The development of a flow chart, or logic diagram, is an early step in the preparation of the computer program.

Division of Regional Medical Programs

THE MAIN PURPOSE of the Regional Medical Programs is to provide the medical profession and medical institutions of the Nation greater opportunities to bring the latest advances in diagnosis and treatment of heart disease, cancer, and stroke to their patients.

The Division of Regional Medical Programs was established to administer the regional cooperative arrangements among medical schools, hospitals, and other clinical and research institutions which were authorized under the Heart Disease, Cancer, and Stroke Amendments of 1965. This legislation grew out of recommendations from the 1964 President's Commission on Heart Disease, Cancer, and Stroke which studied the problems and recommended means to achieve significant results in the diagnosis and treatment of these and related diseases.

In his Special Health Message to the Congress in February 1964, President Johnson stated, "I am establishing a Commission on Heart Disease, Cancer, and Stroke to recommend steps to reduce the incidence of these diseases through new knowledge and more complete utilization of the medical knowledge we already have."

With this mandate, the Commission heard testimony from scores of leaders in medicine and public affairs who cited the many advances in diagnostic and therapeutic techniques made possible by the rapid progress of medical science. This testimony convinced the Commission that the toll of these diseases could be reduced significantly if the latest medical advances already developed, and those developed in the future through extended research opportunities, could be made more widely available to our citizens.

The Commission recognized that the complexities of modern techniques in the fields of heart disease, cancer, and stroke made it difficult to bring these advances to more disease victims.

Believing that the medical resources of this Nation were equal to this challenge if given the necessary assistance and encouragement, the Commission presented a series of recommendations aimed at reducing the toll of these diseases. The major recommendations of the Commission are the basis for the Regional Medical Programs.

The Division of Regional Medical Programs awards grants for the planning and establishing of regional cooperative medical arrangements which link medical centers—usually consisting of a medical school and affiliated teaching hospitals—with clinical research centers, local community hospitals, and practicing physicians of the Nation. Grants may be made for planning and feasibility studies, as well as for pilot projects to demonstrate the value of these arrangements and to provide a base of experience for further development.

In developing the Regional Medical Programs, the cooperation of practicing physicians, medical center officials, hospital administrators, and representatives from appropriate voluntary health agencies is sought. To insure this cooperation, the grant applicant must designate an advisory group to advise the applicant together with the participating institutions, in formu-

lating and carrying out the plan for the establishment and operation of that regional medical program. No interference is made with patterns or methods of financing of patient care, or professional practice, or with the administration of hospitals.

The National Advisory Council on Regional Medical Programs advises and assists the Surgeon General in making policy and regulations regarding the Regional Medical Programs, and makes recommendations to him concerning approval of applications and amounts of grant awards. The Council consists of the Surgeon General as Chairman, and 12 leaders in the fundamental sciences, the medical sciences, or public affairs. One of the 12 council members is required by law to be outstanding in the field of heart disease, 1 in cancer, and another in stroke, and 2 must be practicing physicians.

The Division of Regional Medical Programs provides a key opportunity for the medical resources of the Nation to engage in long-range, coordinated planning and development beyond the scope of existing programs and facilities.

The specific design of individual regional plans and programs depends on the facilities and resources available and the relationships which are established among these resources by their own initiative. Coordinated patient referral, interchange of personnel, continuing education for physicians, the provision of equipment, training in the use of this advanced equipment, and the development and support of medical teams trained in the latest techniques for diagnosis and treatment may all be aspects of the regional cooperative efforts which can be carried out.

Such a comprehensive opportunity should make possible the most effective provision of quality medical care for all citizens and enable every region of the country to meet its own needs and goals for coping with major disease problems.

Office of Administrative Management

THE OFFICE OF ADMINISTRATIVE MANAGEMENT is responsible for providing staff support to insure to line management the availability of people, appropriated funds, working space, supplies, communications, and protective services needed for the research and research support programs of the National Institutes of Health.

In fulfilling these responsibilities, the Office of Administrative Management plays a dual role—advisor and coordinator for the Director in his capacity as principal administrator of a multimillion dollar undertaking, and service organization in support of the NIH research effort. OAM oversees the preparation and submission of the budget and related financial documents, and accounts for and disburses the moneys appropriated to NIH; develops and evaluates policies and gives technical guidance in such fields as personnel, property, and supply; conducts management improvement studies; assures that appropriate measures are taken for the physical safety and security of people, property, and equipment; and consolidates and issues administrative policies and procedures.

In providing service to the NIH community, the Office of Administrative Management makes every effort to supply the needs of the research scientist and

research planning staff, and to free them of excessive administrative detail.

The need for qualified people to conduct research, administer the far-flung research grants programs, and staff the various supporting services has led to the development of new methods for locating promising candidates, developing their capacities while on the job, and in general making NIH an attractive place to work, for the professional and nonprofessional alike. Examples of these new approaches for which assistance was provided include the Staff Fellowship Program for bringing brilliant young scientists to NIH as researchers, and the NIH Research Grants Assistants Program for the training of scientist-administrators.

With NIH's expanding programs, the matter of housing new projects is often of utmost urgency. Space for new offices, laboratories, shops, and warehouses must be planned in advance of actual need, and once occupied must be tied into the main network of communications by telephone, mail, and transportation services. Space must also be maintained, cleaned, and provided with guard and fire protection services.

The supplies, equipment, and services needed to conduct research range from alligators to electron microscopes. Some of these items are as close to the scientist as his telephone, using the successful "telephone charge-order" system. Others are immediately available at NIH, as for example, stationery items, which can be picked up at the self-service store, and duplication services, which are provided by the printshop (which also sees to the printing of a large volume of official papers and reports). Acquisition of still other items requires prolonged negotiation by the research contract staff. Under the charge-order system, and in some other cases, material is delivered directly to the person placing the order.

In these and many other ways, the OAM staff plays its part in support of research, and in carrying out management responsibilities in the administrative area.

Office of International Research

The international health research act of 1960 (P.L. 86–610) authorized the Surgeon General of the Public Health Service to carry on "cooperative endeavors with other countries in health research and research training." By supporting selected research projects among the many opportunities offered abroad, the National Institutes of Health has been able to supplement domestic resources in quality and scope by promoting the advancement of the health sciences and thereby the health of the American people.

Recent years have seen a rapid growth of the scope and magnitude of international medical research activities. Although less than 3 percent of NIH extramural grant funds have direct and substantial foreign implications, the cost of the oversea portion of the extramural programs represents an investment of approximately $20 million annually.

In order to assume adequately the increasing responsibilities for studying, planning, and advising on these vast international activities, the Office of International Research was established within the NIH in 1961. This office is part of the Office of the Director and is responsible for coordinating all international activities of the National Institutes of Health. It advises the

Director and the Office of the Surgeon General on matters relating to the international aspects of medical research and research training and assists the Institutes in the development of international extensions of their programs. It is specifically responsible for administration of the NIH Special Foreign Currency Program which utilizes U.S.-owned foreign currencies, and for coordinating Institute proposals for research under this program in foreign countries.

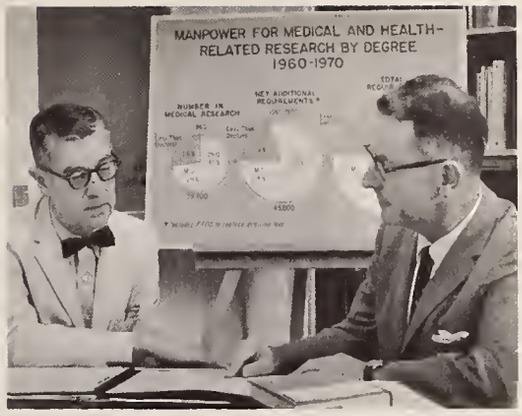
In order to assist the Office of International Research in fulfilling these responsibilities, and to enable it to evaluate foreign medical research and scientific manpower opportunities, and stimulate the flow of information on medical research in other countries, NIH has established oversea offices in Paris, France; Rio de Janeiro, Brazil, and Tokyo, Japan, and Science Representatives in London, England, and New Delhi, India. Since their inception, these offices and representatives have provided a continuous flow of information to the Bethesda office which has proved of invaluable assistance to the Director of NIH in determining the extent of programing overseas and the support which should be provided to biomedical research and research training in foreign countries.

In addition to the functions mentioned above, the Office of International Research is directly responsible for the administration of the International Postdoctoral Fellowship Program, the International Centers for Medical Research and Training, the Visiting Scientist Program, and the International Research Career Development Program. A recently acquired responsibility of the Office of International Research has been the administration and coordination of a new program of collaborative biomedical research between the United States and Japan.

The Nutrition Section of OIR, formerly the Secretariat of the Interdepartmental Committee on Nutrition for National Defense, conducts an international multidisciplinary program aimed at improving the nutritional status of populations in the United States and in developing countries throughout the world. Although the main activity of the Nutrition Section is the organization and execution of nutrition surveys in various countries, the Section has participated activity in the programs of many international organizations, including WHO, PAHO, SEATO, FAO, INCAP, etc., and has recently been represented on the President's Food for Peace Program.

Public Health Service physicians and two Pakistan doctors examine cholera patient in hospital at Matlab Bazer, East Pakistan.

Office of Program Planning



The expansion of medical research in recent years, largely a result of increased Federal support, places upon the National Institutes of Health a heavy responsibility to assess the effects of such growth and of probable future change. Decisions concerning program development, policy formulation, and administration demand continuing study, analysis, and planning.

The Office of Program Planning is organized to support the NIH Director in the discharge of his broad administrative and leadership functions. The diversity and scope of NIH operations require that the Director have a strong analytical and planning staff to undertake searching reviews and analyses of NIH policies, plans, and programs; to pose key questions; and to integrate the planned programs of the several Institutes and Divisions into an overall program plan for NIH projected several years into the future. This is one of OPP's central functions.

Authority to conduct NIH programs derives from numerous acts of Congress and Executive decisions. As social and scientific changes affect the direction and pattern of medical research, the legislative base may need to be modified. And new legislative proposals must be assessed for their possible effect on NIH programs. Thus, an important area of responsibility for OPP is legislative reference and liaison.

Another responsibility of OPP is the study and evaluation of external factors and trends affecting NIH activities. In particular, national resources for medical research—funds, facilities, and manpower—are investigated, with due attention to socioeconomic and other forces influencing medical science. Reports on these studies are issued widely from time to time. Typical have been reports on patterns of science enrollment in the Nation's leading graduate schools. *Resources for Medical Research*, a series, has reported on Federal research expenditures.

Special studies by request constitute another area of activity. These involve planning and reporting, often in connection with emerging problems. Many concern various aspects of the NIH mission. Resulting documents, reports, articles, and so forth are directed to staff members, other Government agencies, the Congress, and special non-Federal groups. Among the special studies are those conducted by the NIH historian.

The NIH Director and his immediate staff must be advised of implications of OPP's findings. This function, and participation in the planning that results, are other continuing responsibilities.

Office of Research Information

THROUGH THEIR TAXES the people of the United States support more than half the medical research of this country—more than one-third of it through appropriations to the NIH; thus, they have a clear right to know of the results achieved by this expenditure.

Following World War II there was a tremendous surge in interest in professional and public support of medical research and, concurrently, new and broadening informational activities gradually evolved. The scientists pursuing their researches found that they no longer had the time to carry on the informational activities demanded by the press and the public, and the "information specialist" arose to meet this need.

As the Institutes and Divisions were established at the National Institutes of Health, the information role was recognized in establishing legislation.

Each of the nine Institutes and six Divisions of NIH, therefore, has an information office; and all of them have three objectives in common: to promote the improvement of the health of the American people; to report on all NIH activities and accomplishments; and to aid in a public accounting of Federal expenditures for medical research.

The Office of Research Information, as a part of the Office of the Director, NIH, dates from 1955. At that time ORI was given responsibility for providing staff advice to the Director on matters of public and professional information; for handling new and noncategorical information responsibilities; for the coordination of the information activities of the various Institutes and Divisions; for information liaison with the Public Health Service and the U.S. Department of Health, Education, and Welfare; and for insuring that Public Health Service-Department of Health, Education, and Welfare information policies were being followed.

The ORI plans, collects, prepares and disseminates information materials that describe the content and scope of existing research and research training programs, and of NIH research accomplishments. These materials are prepared for various audiences, including the Congress, the medical profession, and the general public.

The ORI reviews all materials prepared at NIH which are intended for publication. This includes articles, scientific reports, leaflets, brochures, and news releases. It publishes the *NIH Record*, a biweekly newspaper distributed to all NIH employees and, upon request, to medical organizations and individuals throughout the United States and abroad. ORI also publishes and distributes the NIH Calendar of Events (a listing of scientific meetings at NIH and in the Washington area) and the *Scientific Directory and Annual Bibliography.*

The American citizen wants to know and must be told of the results of science if he is to be an informed and productive citizen in the 20th Century. The ORI and the information staffs of NIH seek to bring to the citizen the knowledge he needs about the results of medical research today.

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11A Incinerator Building

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12A Management Policy Branch; Clinical and Professional Education Branch, Clinical Center; Division of Biologics Standards; Division of Research Services; National Heart Institute; National Institute of Child Health and Human Development; National Institute of Dental Research; National Institute of Mental Health

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17A Electrical Power Plant

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26 Chemical Disposal

28 Dog Kennels; Animal Hospital

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30 National Institute of Dental Research; National Institute of Neurological Diseases and Blindness

31 General Office Building

32A Greenhouse; National Institute of Mental Health

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